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CONTENTS OF VOL. XIV.

1888.

No. 1.—January 1888.

I.—Articles, Correspondence, &c.— PAGE.

A Forest Tour among the Dunes of Gascony, ... 1
The Influence of Forests on Rainfall, ... 10
Indian Seeds in New Zealand, ... 20
Nitrogen Gas in Swamps, ... 21
The Humane Sportsman, ... 22
Forest Fires in Greece, ... *ib.*

II.—Reviews—

Bamonpokri Working Plan, ... 23
The Forests of Jamaica, ... 27
The Forests of St. Vincent, ... 31

III.—Notes, Queries and Extracts—

Influence of Forests on Rainfall, ... 34
Fairy Rings, ... 48

No. 2.—February 1888.

I.—Articles, Correspondence, &c.—

A Forest Tour among the Dunes of Gascony, (concluded,)... 49
Some facts regarding the Production of Resins and Turpentines in India, ... 63
Cutch Exports from Upper Burma, ... 70
Compounding Forest Offences, ... 72
Reproduction of Bamboos, ... 73

II.—Review—

Forest Administration in British India, 1885-86, ... 75

III.—Notes, Queries and Extracts— PAGE.

M. Potanin's Journeys in East Tibet and East Gobi, ... 89
The true cause of the Breaks in the North-Western Railway, ... 92
The Forestry Committee, ... 94
Light and the formation of Flowers, ... 95
Forests as Protection against Floods, ... *ib.*
Analysis of Forest Products, ... 96

No. 3.—March 1888.

I.—Articles, Correspondence, &c.—

The road to Pangi (Chamba), ... 97
Charcoal for Gunpowder, ... 109
Treatment of Bamboos, ... 112
Date Culture, ... 114
The Cedars of Lebanon, ... 117
Decay of Posts at the Ground Level, ... 119
Magnesite at Mussoorie, ... 120

II.—Review—

Timber and some of its diseases, ... 121

III.—Timber Market— 126

IV.—Notes, Queries and Extracts—

Forest Preservation, ... 128
In the Himalayan Country, ... 133
The Forestry of West Africa, ... 137
The Annual Floods in the Punjab, ... 140
Reclamation of Usar Lands in Berar, ... 141
Treatment of Plants Attacked by White-ants, ... 143

No. 4.—April 1888.

I.—Articles, Correspondence, &c.—

Impressions of a Month in the Forests of South Berar, with special reference to "Light-Grazing," 145
The Nilgiri 'Strobilanthes,'... 153

PAGE.

The Mineral Concretion of the Teak tree, ... 159
Timber *versus* Metal Sleepers, ... 161
Comparative Temperatures on Hill Stations and in the Plains in the N.-W. Provinces, India, ... 164
Compounding Forest Offences, ... 166
Notes on Insect Ravages in Pine Forests, ... 167
Weisse's Height Measurer, ... 169

II.—Review—

The Financial Statement, 1888-89, ... 171

III.—Official Paper—

Memorandum on the System of Management of the Sub-montane Forest Divisions of the Central Circle, N.-W. Provinces and Oudh, ... 173

IV.—Timber Market—

Messrs. Churchill and Sim's Circular, ... 187
Andaman Padouk Timber, ... *ib.*

V.—Notes, Queries and Extracts—

A Neglected duty of Government, ... 188
The Insect Pests of India, ... 192

No. 5.—May 1888.

I.—Articles, Correspondence, &c.—

Changes at the Nancy Forest School, ... 195
Mineral Deposits in Wood, ... 197
Treatment of Bamboos, ... 200
Memorandum on Date Culture, ... 203
Rhynchota of India, ... 205
Memorial of the Corporation of Southampton, ... 206
Board of Forestry, ... 207
Imperial Forest School, Dehra Dún, ... 208
Edible Lichens, ... 209
Organic Chemistry at Cooper's Hill, ... *ib.*

II.—Reviews—

Forestry in the United States, ... 210

PAGE.

Report on the Canal Plantations, N.-W. Provinces and Oudh, for the year ending 31st March, 1887, ... 224
Description of Gear employed for facilitating the Transport of Timber by Land, ... 228

III.—Official Paper—

Insects injurious to Forests, ... 232

IV.—Notes, Queries and Extracts—

Conifers—The Southern or Pitch Pine, ... 237
The American Spruce Fir, ... 239
The Timber Trade, ... 241
The Bijnor Thandá Tokri, ... 242
Forestry in Victoria, ... 236

No. 6.—June 1888.

I.—Articles, Correspondence, &c.—

The Grazing Question in Jaunsar, ... 243
Ring-barking in Australia, ... 250
Resin Production in the Jaunsar Forests, ... 255
Reclamation of Usar land in Behar, ... 256
Compounding Forest Offences, ... 257
Compounding Forest Offences, ... 259
Dehra Dún Fishing Association, ... 260
Admission of Natives into the Class of Sub-Assistant Conservators, ... 262
Height Measurer, ... 263
Forest set on fire by Lightning, ... 264

II.—Reviews—

The Journal of the Agricultural and Horticultural Society of India, ... 265
The Quarterly Journal of Veterinary Science in India, ... 267

III.—Official Paper—

Indian Fibres suitable for textile purposes, ... 269

IV.—Notes, Queries and Extracts—

The Forestry School at Cooper's Hill, ... 277

PAGE.

The further Development of the Teak Trade, ... 282
The most efficient means for Preserving Wood, ... 285
Mahogany Experiments in Southern India, ... 287
The growth of Rain Drops, ... 289

No. 7.—July 1888.

I.—Articles, Correspondence, &c.—

The Forests of Manipur, ... 291
Improvement Fellings in the Dehra Dún Sál Forests, ... 299
Does the cutting down of a Forest on a Hill decrease the quantity of water given out by the springs at the foot of it? 304
Notes on the small Bamboos of the genus *Arundinaria*, ... 306
Dendrometers, ... 314
Compounding Forest Offences, ... 316
Forestry at the Cape, ... 317
Authentic case of Forest fire caused by Lightning, ... 318
Rathi Puvu (Rock flower), ... *ib.*
Appropriation of Land under Section 28 of Forest Act, ... 319
Cattle straying into Plantations, ... *ib.*
Tunis and Persian Date Plants, ... 320
Forest Tour of Cooper's Hill Students, ... 321

II.—Review—

Timber and some of its diseases, ... 322

III.—Timber Market—

Churchill and Sim's Wood Circular, ... 324

IV.—Notes, Queries and Extracts—

Sketch of the Forestry of West Africa, ... 325
The Great Nova Scotia Raft, ... 331
Upper Burma Forest Leases, ... 334
Floral Barometers, ... 337
Training of Ceylon Forest Officers, ... 321
Rhea Fibre, ... 323

No. 8.—August 1888.

I.—Articles, Correspondence, &c.—

The Forests of Manipur, (continued,)... 339

PAGE.

Annual Meeting of the American Forestry Congress, ... 344
Pensions and Furlough Allowances for the Uncovenanted Service, ... 351
Recording results of protection of Forests from fire, ... 355
Compounding Forest Offences, ... 357
The Nala Pani Springs, Dehra Dún, ... 359
Lower California,... 360

II.—Reviews—

The Botany of the Afghan Delimitation Commission, ... 361
Forestry in the Andamans, ... 373
The Forests of Tasmania, ... 376
Report on Calcutta Botanic Garden, 1887-88, ... 378

III.—Notes, Queries and Extracts—

Forests of Tunis,... 380
The Trout's Precept—and Practice, ... 382
Sál Trees in the Garo Hills, ... 386

No. 9.—September 1888.

I.—Articles, Correspondence, &c.—

The Forests of Manipur, (continued,)... 387
Dr. Cleghorn's Services to Indian Forestry, ... 395
Prize Day at Cooper's Hill, ... 401
Annual Meeting of the American Forestry Congress,(contd.,) 408
Acting Allowances, ... 415
How to Baffle Mosquitos, ... 416
The Brandis Prize, ... 417
Bamboos for Fishing Rods, ... 418
Fruit in the Dehra Dún, ... 419
Wood used for Tea Boxes in Calcutta, ... 420
Coppice shoots of *Dalbergia paniculata*, ... 421
Beddome's Flora Sylvatica, ... 422

II.—Reviews—

Professor Wallace and Indian Forestry, ... 423
Forestry in the Cape Colony, ... 428
Forestry in the Straits Settlements, ... 430

PAGE.

III.—NOTES, QUERIES AND EXTRACTS—

The Timber Acts (Ireland) Amendment Bill, ... 433
Pigeons hatching out a Chicken, ... 434

No. 10.—October 1888.

I.—ARTICLES, CORRESPONDENCE, &C.—

The proposed School of Forestry at Edinburgh, ... 435
Annual Meeting of the American Forestry Congress, (contd.,) 447
The Scarcity of Fuel at Darjeeling, ... 456
A Note on the Apparatus required for collecting Insects in India, ... 463
Compensation under Forest Act for illicit Fishing, ... 466

II.—REVIEWS—

Forestry in Bombay, ... 468
Notes on Forest Management in Germany, ... 479

III.—TIMBER MARKET—

Messrs. Churchill and Co.'s Wood Circular, ... 482

No. 11.—November 1888.

I.—ARTICLES, CORRESPONDENCE, &C.—

Report on the better Conservancy of Forests on hills surrounding Mount Abu, ... 483
Annual Meeting of the American Forestry Congress, (concld.) 495
Beetle destructive to Sál Coppice Shoots, ... 503
Inaccurate Account of Indian Woods, ... 504
The Status of Forest Rangers, ... 505
Dendrometers, ... 506
Forestry in a Native State, ... 507

II.—REVIEWS—

Forestry in Madras, ... 508
Agriculture in Russia, ... 513
Forest Conservancy in the Jeypore State, Rajputana, ... 517

PAGE.

III.—Timber Market— 521

IV.—Notes, Queries and Extracts—

Forest Conservancy in Ceylon, ... 522

No. 12.—December, 1888.

I.—Articles, Correspondence, &c.—

Forestry in Hungary, ... 531
A Government Grass Farm in India, ... 547
Sleeper Slide, ... 553
Pine Resin in Jaunsar, ... 555
Seeding of *Prosopis spicigera*, ... 557

II.—Review—

Forest Conservancy in the Central Provinces, ... 559

III.—Official Paper—

Five-year Plan of Operations for the Rehar and Makonia Forests, ... 564

IV.—Notes, Queries and Extracts—

Discovery of Fossil Trees near Glasgow, ... 573
Kawrie Pine, ... 574
The Longevity of Trees, ... 576
The Great Log Raft, ... 577
The Teak Market, ... *ib.*
Manual of Indian Sylviculture, ... 578
Forest Conservancy, ... 558

Extracts from Official Gazettes— 1

ERRATA.

'*Notes on a Forest Tour in Bavaria.*' *November No. of* '*Indian Forester*'

Page 502, line 27, *for* 'two fungi,' *read* 'the fungi.'

„ 508, line 8, omit the word 'bends.'

„ 510, lines 1, 2, *for* 'At present the right is not,' *read* 'Formerly the right was not.'

„ 511, line 10 from bottom, *for* 'Chalcozraphus,' *read* 'Chalcographus.'

„ 512, last line but one, *for* 'Sabzkammergut,' *read* 'Salzkammergut.'

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A FOREST TOUR AMONG THE DUNES OF GASCONY.*

By Lieut.-Col. F. Bailey, R.E.

CHAPTER I.

THE LANDES AND DUNES OF GASCONY.

Introduction.

Our party, consisting of M. Boppe, five English students, Mr. Beckington, an American gentleman interested in forest questions, M. Borel, a Swiss student, M. Takasima, and the writer, left Bordeaux early on the 26th April, 1886, for Arcachon. We were accompanied by MM. de Monteil and Moyse, Inspectors, and M. Foulon, Assistant Inspector, who were so kind as to conduct us to the various points of interest we had come to study. Leaving the train at La Teste, we spent some time in going over a resin factory close to the railway station; and then walked two miles across the dunes to Arcachon. After breakfast, we made an excursion to the Mouleau block of the forest of La Teste; and passing through it, gained the beach, which we followed, in a southerly direction, for a considerable distance, until we reached a portion of the dunes, where a forest—which had previously been established—was sold in 1863 to a private proprietor. He has neglected to maintain the works, and the result is that the forests are being gradually ingulfed. Our long walk home over the deep sandy track, in a

* Reprinted from "Transactions of the Scottish Arboricultural Society," Vol. XI, Part iii, 1887.

heavy shower of rain, the last few miles being in almost total darkness, was the least enjoyable part of the day.

Next morning, we travelled some miles by train, and then walked into a portion of the forest containing a number of old cluster pines (*Pinus pinaster*), which have been worked for resin for the last 150 or 200 years. We then walked to the village of La Teste, and caught the evening omnibus to Arcachon.

On the 28th, we travelled by train to Labouheyre, where we were met by M. Mörch, Assistant Inspector, and M. Lamarque, *Garde-Général*. The latter gentleman has been employed here since 1850, and has supervised the fixing and planting of 85 square miles of dunes. Accompanied by them, we drove to St. Eulalie, a distance of 12½ miles, stopping on the way to look over a factory, established in the forest for the manufacture of oil from subsubstances contained in the pine wood; we then mounted ponies, and rode to the sea-shore, for the purpose of inspecting the works that have been there erected to check the formation of dunes. We reached Mimizan, where we were to sleep, late in the evening.

Next day, we rode to another part of the sea coast, to look at some works more recent than those we had previously seen, and also to study a locality in which they have been neglected, and must now be partially destroyed and afterwards reconstructed. We then returned to Mimizan, and drove back to Labouheyre, where we visited a factory belonging to the railway company, in which pine sleepers and telegraph poles are impregnated with sulphate of copper. In the evening we took the train for Dax, on the banks of the Adour.

What we saw and learnt while among the dunes will now be briefly treated of under the following heads, *viz.*:—

1. General Description.
2. Construction of the Works.
3. Treatment of the Cluster Pine.
4. Tapping for Resin.
5. Manufacture of Products.
6. Utilisation of the Wood.

General Description.

From the mouth of the Gironde down to Bayonne, a distance of some 125 miles, the western portion of the departments of Gironde and Landes forms a vast plain, about 18 or 20 miles wide, the soil of which is sandy and extremely poor. This tract of moor-

land (*landes*), which gives its name to the southern of the two departments, is inhabited by a population, formerly almost entirely pastoral, whose villages are scattered over it, and who cultivate scanty crops upon the fields surrounding their dwellings. But from time immemorial, and until comparatively recent years, the *landes* have been subjected to a never-ceasing invasion by sand, which, driven over the plain from the sea-shore, in the form of moving hills, called *dunes*, has completely covered a strip of 8 or 9 miles in width, and would, if unchecked, have ultimately laid waste the entire district. The aspect of the country, before steps were taken to improve its condition, must have been uninviting in the extreme ; the *lande rase*, or barren moorland, stretching towards the sea, was then bounded by the *dunes blanches*, or white sand-hills, which, rising near the coast to a height of some 230 feet, had already buried below them many a village spire, and their irresistible advance seemed to render certain the destruction of everything lying in their path. The church of Mimizan has been thus partially covered ; and, at a short distance from the village, a mound was pointed out to us, under which lies a buried hamlet. The village church of Soulac was completely overwhelmed, but was disinterred a few years ago ; and M. Lamarque told us that he often ties his horse's bridle to the top of a certain church steeple!

But this state of desolation no longer exists. The barren moorland is now stocked with a nearly continuous forest of the cluster pine (*Pinus pinaster*), which, covering also the rolling dunes, has completely arrested their advance ; and from various elevated points which we ascended near the coast, as well as from La Truc, in the forest of La Teste, the dark green undulating upper surface of the pine forest meets the deep blue of the western sky, and, looking landwards, there is nothing else to be seen. Indeed, throughout the many miles we travelled by rail, by carriage, or on horseback, through this part of the country, we became positively weary of the monotonous appearance of these trees. They are, nevertheless, undoubtedly the saviours of the land. They not only avert the destruction of existing fields and villages, but also profitably occupy vast areas of sand-hills, and of the low-lying, marshy, and unhealthy ground between them ; and they thus provide employment for the population, who are nearly all engaged, during the summer months, in the collection of resin, and, at other times, in felling, cutting up, and exporting timber, or on other work which the forests offer to them. The people, however, still keep large flocks and herds, the guardians of which are to be seen, mounted on stilts

about 3 feet high, driving or following their animals through the dense undergrowth of prickly gorse and other shrubs.

The climate may be described as a mean between that of the Parisian and Provençal regions. The annual rainfall, of from 28 to 32 inches, is well distributed, so that the air seldom becomes excessively dry, as it does during the summer on the shores of the Mediterranean ; and thus, where the quality of the soil admits of it, a fairly varied vegetation is produced. But this condition is rarely satisfied, for the deep soil of the dunes is excessively poor, and the number of species growing on it is extremely limited. Very few shells are found on this coast ; the soil contains but little lime, and not more than from 3 to 6 per cent. of substances other than fragments of quartz. It is surprising to note what a luxuriant vegetation is produced under such circumstances. The cluster pine, which is mixed in places with a few oaks (*Q. pedunculata*), and a small proportion of other species, attains considerable dimensions ; and there is a dense undergrowth, consisting of broom, gorse, heather, ferns, and other plants, which commonly flourish on silicious soil. On the old plain of the *landes*, the sand is mixed with a considerable quantity of vegetable *débris*, and contains much iron, an impermeable stratum of ferruginous sandstone (*alios*), mixed with more or less organic matter, lying at a short distance below the surface.

The first works were undertaken here, in the year 1789, by M. Brémontier, an engineer, whose memory is honoured at Labouheyre by a bust, mounted on the same pedestal upon which, until the days of the Second Empire closed with the disasters of 1871, stood the statue of Napoleon III. *Tempora mutantur !* The Forest Department took charge of the operations in 1862. But it is certain that the cluster pine either grew spontaneously in this region, or had been introduced into it, long before M. Brémontier's time ; for in the old part of the forest of La Teste, near Arcachon, we saw trees which must have been 200 years old, and the process of extracting resin from which had apparently been carried on for at least 150 years. This pine, which now constitutes the principal wealth of the district, is eminently adapted for the use to which it has been put ; it grows splendidly on the soil and in the climate of the south-west coast, while it possesses a well-developed tap-root and strong lateral roots, which send down numerous secondary vertical roots to force their way deeply into the soil, thus holding it together, and enabling the tree to draw its supply of moisture from a great depth ; at the same time the resin which it yields is very valuable. Although the cluster pine is found north of the

Gironde, it is there much less vigorous and yields less resin ; while in the valley of the Loire it no longer grows spontaneously, and it loses nearly all its valuable qualities.

A special law relating to the dunes was enacted in 1810, its principal features being that the State can order the planting up of any area which, in the public interest, requires to be so dealt with ; and that when the land belongs to communes or private proprietors who cannot, or do not wish to, undertake the work, the State can execute it, reimbursing itself, with interest, from the subsequent yield of the forest. As soon as the money has been recovered in this manner, the land is restored to the proprietors, who are bound to maintain the works in good order, and not to fell trees without the sanction of the Forest Department.

Construction of the Works.

The dunes are formed by the combined action of the wind and sea. Each ebb tide leaves a quantity of sand, a portion of which dries before it is covered by the next flow ; it is then liable to be blown away by the wind. The individual sand grains, which are not, generally speaking, either sufficiently large to resist the force of the strong westerly breezes blowing from the sea towards the low plain which bounds it, nor sufficiently small to be carried away in the air in the form of dust, are driven along the surface of the ground, rarely rising to a height of more than 1½ or 2 feet, until they meet with some obstacle which arrests their course, and thus promotes the formation of a little mound. Up this mound succeeding sand-grains are propelled, and on reaching its summit they fall down the sheltered reverse slope at a steep angle. In this manner sand-hills or dunes, rising sometimes to a height of 200 to 250 feet, are formed, the line of their crests being, generally speaking, perpendicular to the direction of the prevailing winds, that is, in the case of the tract between the Gironde and Bayonne, parallel to the general line of the sea-shore. This action is not completely regular. The formation of some of the dunes is commenced close to the sea, while others have their origin at some distance from it ; and fresh importations of sand either add to the bulk of those already existing, or, being blown through breaks in the chain, pass on till they encounter some other obstacle. But the sand-hills themselves are kept moving slowly landwards by the wind, which drives the upper layer of sand from the gently-sloping outer face, up to the summit, whence it falls down the steep slope on the landward side ; and this process being continued whenever there is enough wind to produce it, the dunes are moved, or rather rolled,

inland by slow degrees. As fresh mounds are formed near the sea, which are in their turn moved onwards, it follows that, in the course of time, the whole surface of the plain has become covered with sand-hills, for a distance of several miles from the coast. The rate at which the sand thus advances is very variable. Sometimes, during many months, there is no perceptible encroachment, while at others the movement is very rapid, amounting to 60 or 70 feet in the year; the average annual rate is said to be about 14 feet. But the sand-hills do not move at an uniform rate of speed. Some, overtaking those in their front, become merged in them; while they all undergo changes of height and form, so that the whole surface of the country is continually in motion, being turned over and over to a great depth, and under these conditions it is impossible to grow anything on it. The source of the evil lies at the sea beach, and the first thing to do is, evidently, to stop fresh importations of sand. As regards the dunes already formed, it will be seen, from what has been said, that the movement, at any particular time, is confined to the sand then at the surface; and if this can be fixed, during the time necessary to enable a crop of herbs, shrubs, and young trees to be raised upon it, the movement of the entire mass will have been arrested.

We rode from St. Eulalie, through the forests, to the coast near Mimizan-les-Bains, where M. Lamarque explained to us that the system by which this is accomplished consists in promoting the formation, by the wind, of an artificial dune, close to the sea, and, generally speaking, parallel to the water-line at high tide. This mound absorbs the fresh importations of sand; and, under its shelter, sowings are made, which, extending gradually inland in parallel bands, fix and consolidate the surface of the naturally-formed sand-hills. Ultimately, the artificial dune is itself planted with trees, and the evil is then cured, for so long a time as care is taken to maintain the works, which are commenced as follows:—At a distance of about 165 yards from high-water mark, a wattled fence, 40 inches high, is erected, the pickets being driven 20 inches into the sand. This serves to arrest the sand, which is heaped up on the seaward side, a portion of it filtering through the wattles. After a time, the fence is overtopped, and the sand, blown up the outer face, forms a steep slope on the other side. A second wattled fence is then erected, about 6½ feet behind the first, and the space between the two becomes filled up, a mound rising over it. The sand which falls over this obstacle then stands at a high angle against the reverse side of the second wattle. In the centre of the mound, a palisade of planks, also 40 inches above and 20 inches below ground,

is erected—the planks, which are of pine sapwood, 7 inches or 8 inches wide, and 1½ inches thick, being placed ⅔ths of an inch apart. When the sand drifts up against them, a portion of it falls through the intervals, thus affording support on the other side; and when they have become nearly covered, they are raised about 2 feet out of the ground by means of a hand-lever and chains. This operation, which we saw done, is repeated from time to time, until the barrier has attained a height of about 25 feet, when a third wattle fence is constructed, at a distance of from 5 to 6½ feet behind the inner slope; and the top of the barrier is strengthened by means of a line of small fagots formed of pine branches, gorse, and other shrubs, which are half-buried vertically in the sand. The fagots, each of which weighs about 45 lbs., are placed at distances of 4½ feet from centre to centre. During the time that elapses before the last fence is overtopped, the palisade is not raised, so that the width of the base is increased, and the top becomes broad and rounded. When the palisade, which is now moved back a short distance, becomes overtopped, it is raised as before, an additional wattle being placed in rear of the work; and the building up of the mound, by the action of the wind, is continued in this manner, until it has attained its maximum height of from 40 to 45 feet, when its breadth is allowed to increase, until it stands on a base about 330 feet broad. The foot of the outer slope is then about 100 feet distant from high-water mark, the top being at least 165 feet broad, and the slopes standing at 35 or 40 degrees. This result is usually attained in from 15 to 18 years, but the rate of the barrier's growth is by no means regular. Strong and steady west winds are the most favourable; but when the sand is raised by squalls, it is sometimes carried inland in considerable quantities. The artificial dune must be broad at the top, and its profile must be such that the most violent storms do not easily "take hold" of it; but if these conditions are fulfilled, its maintenance is easy and cheap; and if the base of the outer slope be kept at the prescribed distance from high-water mark, the sea, even if it reaches it during exceptionally bad weather, does the structure but little damage.

The surface of the mound is consolidated by fagots, 12 to 14 inches in circumference, and 14 to 16 inches apart, buried vertically to a depth of 16 inches in the sand, and projecting 8 to 16 inches above ground. It is also sown with *gourbet* (*Arundo arenaria**), about 13 lbs. of seed being used per acre. This plant, which is a kind of grass, with an underground stem and strong interlacing

* Syn. *Psamma arenaria*, Hooker.

what incessant care and watchfulness are required to carry out an undertaking of this kind successfully.

(*To be continued*).

THE INFLUENCE OF FORESTS ON RAINFALL.*

Translated from the German by B. H. BADEN-POWELL, C.S.

IN India generally,—that is to say excluding from our view the regions of higher elevation in the great mountain ranges,—*moisture* is the factor of first rank among the climatic conditions which influence the character of vegetation generally, and in an especial manner that of the forests.

This will be readily understood, in a country lying between the 8° and 35° North Latitude, and sheltered towards the north by the huge barriers of the Himalayan ranges and the Thibetan plateau.

At an early period of my experience in the forest districts of the Indian Provinces, my attention was directed to the observation of the relations existing between the mean annual rainfall and the character of the forests. In the year 1872, when on leave in Europe, I laid before the Geographical Section of the British Association† a map showing four principal zones or regions of equal annual rainfall. The data for the preparation of this map were but incomplete. They were drawn from various sources, principally from James Glaisher's Essay on the Climate of India (1863), which is printed as an Appendix to the "Report of the Royal Commission on the sanitary state of the Army in India." At that time information existed regarding the mean annual rainfall of 160 stations, but these tables were not critically sifted, nor (in many cases) altogether reliable. This map was published on a reduced scale with an article on *Ocean Highways*, in October 1872. The following zones or regions of rainfall were taken :—

1. Two "moist" regions or zones with "abundant" rainfall, *i.e.*, with a mean annual rainfall exceeding 75 inches (1,900 millimètres)—(1), the western zone on the west coast of the peninsula ; and (2), the north-eastern zone ; which includes the coast-districts of Burma, East Bengal and Assam, and extends westward along the outer ranges of the Himalaya in a long narrow strip, as far as the

* A paper read before the German Meteorological Society by Sir D. Brandis, (late Inspector General of Forests.)

† Session held at Brighton in July of the year.

southern slopes of the Dauládhár—an off-shoot of the North-West Himalaya, 32° 15′ North Latitude.

2. Closely following on these two "moist" zones, comes the region of "moderate rainfall," with an annual mean between 30 and 75 inches (760—1,900 m.m.): nearly half of British India belongs to this region.
3. Two dry zones, or regions of diminished rain supply show a mean annual fall between 15 and 30 inches (380—760 m.m.). The first (*a*) is the northern dry zone, a crescent-shaped, but not altogether regularly formed, belt extending across North-Western India: it embraces the greater part of Rájputána, a part of the Panjab, and a small portion of the North-West Provinces.

   The second (*b*) is the southern dry zone, which includes the interior of the peninsula of India, and includes the greater part of the Dakhan and of Mysore.
4. The "arid" or almost rainless region, includes Sind, the south Panjab and a great part of Rájputána. In these districts the yearly rainfall is very small (on an average less than (380 m.m. or) 15 inches), and is both uncertain in quantity and irregular in time of falling.

The boundary lines of these zones were arbitrarily selected; but their definition was at once facilitated and checked by the indications which the vegetation of these different localities afforded.

In the meanwhile, Mr. Henry F. Blanford had organized the Government Meteorological Department, and in the office of this department a revised edition of the rain-map was prepared and published in 1878.* This edition was based on the critically examined *data* of 222 stations. Up to the present time the four main zones above described have been retained, with the same general boundaries as those laid down in 1872.

A large scale map by Mr. Blanford, published in 1883, gives a more complete representation of the distribution of rainfall. It shows *nine* zones, and is based on the observations of nearly 1,300 stations.

The distribution of rainfall over the seasons of the year, in different provinces, is illustrated by three instructive maps which accompany the "Statistical Atlas of India" shown in the Indian and Colonial Exhibition of 1886. These exhibit the temperature and the rainfall in the hot season (March—May) in the rainy

* As an Appendix to J. S. Gamble's Manual of Indian Timbers, Calcutta 1881.

season (June—October), and the cold season (November—February).*

For the purpose of comprehending the relations subsisting between the forest and the rainfall, the four zones or regions originally adopted (as above described) are both well adapted and sufficient.

No explanation is needed in remarking that the natural distribution of forest trees in India is not *solely* dependent on the greater or less degree of moistness of climate. The teak (*Tectona grandis*) for instance is wanting in forest tracts north of 25° North Latitude, because the species will not stand the night frosts of the north Indian cold season. Even though it may be reared under garden cultivation as far as the 32° North Latitude, it cannot hold its own in the forest against other trees able to bear the cold. Sandal wood (*Santalum album*), the characteristic species of the southern dry zone, is not found in the similar northern zone; because there the temperature in winter is too low. On the other hand, species of *Acacia* and other trees are found in the northern zone which do not occur in the southern. Again, other species like the sál (*Shorea robusta*), require special soil-conditions, and are not found where these are absent, even though the climatic conditions may be otherwise favorable.

Moreover, the natural distribution of forest species depends on yet other factors, with which the climate and the conditions of the soil at the present time, have nothing to do.

In the eastern moist zone, in Assam, Eastern Bengal and Burma, species of the genera *oak* and *pine* occur in the hills as well as in the plains. But in the forests of the west coast of further India (in the western moist zone), both in the hills and in the plains, *oaks* and *pines* (as well as other genera) are altogether wanting; notwithstanding the fact that the climate closely resembles that of corresponding localities in Burma, that the soil-conditions are similar, and that the forests *have* many other species common to both zones. For the full explanation of these and similar facts, the study of the conditions of the present era is not sufficient: we must go back to the development of the plant-world in geological ages preceding our own.

Nevertheless there are very close relations between the character

* The latest collection of observations made regarding the rainfall in India is to be found in Blanford's Indian Meteorological Memoirs, Vol. III., Part I., the "Rainfall of India," Calcutta 1886, with rainfall maps for the three seasonal divisions of the year, according to observations up to 1883; and the Report on the Meteorology of India in 1884 which carries the data a year further.

of the forest and the amount of annual rainfall in India. These relations are best realized and exhibited by following attentively the gradual changes which takes place as we pass from the moister to the drier districts.

On the west coast of further India, for instance, the rainfall increases notably from north to south, attaining its maximum at the 13° North Latitude.

Let us imagine ourselves to be taking a journey into the interior, and commence by passing through the most densely populated part of the coast districts, where the emerald green rice fields are sprinkled over with cocoanut palms; we gradually ascend, as we travel eastwards, to low terrace-cultivation, occupying the valleys which branch off continually, one from the other, and are closed in by wooded hills: ascending still, we reach extensive tracts of luxuriant forest on the ghâts. In one part of these forests the trees lose their leaves during the dry season; and here the teak has its home. The valleys and the western slopes of the ghât mountains, on the other hand, are clothed with thick evergreen forest, consisting of a vast variety of deciduous trees mostly belonging to the families of tropical vegetation. The trees attain not infrequently, a general height of 180—200 feet, and the space between the stems is occupied not only by a dense undergrowth, but also by many young trees, the crowns of whose progenitors weave a thick roof of foliage overhead. Here and there through the forest may be found tree ferns, palms, and bamboos, which stamp the forest with a character of its own. This dense forest of evergreen deciduous trees is specially characteristic of the moist regions of tropical India; it is found to extend over the ridge of the ghâts in a mere strip along the summit of the eastern side, and in sheltered valleys and moist slopes. The further we proceed eastward from the ridge of the ghâts, the drier becomes the climate, and the character of the forest changes accordingly.

The sanatarium of Mahábaleshwar, well known as a hot weather resort from Bombay, lies in 18° North Latitude on the ridge of the ghâts, about 45 miles distant from the sea coast and 5,500 feet (1,380 metrès) above the sea level: Ratnagirí, the next large station on the coast, has a mean annual rainfall of 104 inches, and of this quantity nearly the whole falls in the five months of the south-west monsoon (June to October). When these warm air currents, laden with moisture, come in contact with the steep western face of the ghâts, they are driven aloft, and the result is a still heavier downpour of rain on the heights. Mahábalesh-

war has (taking the average of 30 years) a rainfall of 260 inches (6,604 m.m.), and of this quantity 256 inches are due to the five months of the south-west monsoon. But the moist zone does not extend far into the interior. From the ridge of the ghâts the country falls gradually eastward, towards the plateau of the Dakhan, which is intersected with lines of hills; the bottom of the valleys and the plain tracts having a mean elevation of about 1,600 to 1,700 feet (500 to 600 metrès). Some 10 miles eastward of Mahábleshwar, and at a somewhat lower elevation than this, lies Pánchgani, with a rainfall of only about 50 inches; and Poona in the Dakhan, at 18° 28′ North Latitude, and 1,840 feet (564 metrès) above the sea level, being also 30 miles from the edge of the ghâts, has a rainfall of not more than 28 inches. As already explained, a narrow belt of evergreen forest extends along the crest of the ghât mountains. When mountain spurs branch off from the main ghâts on the east side, (*i. e.*, inland,) the evergreen forest may still be found, but as a narrow strip along the crest of spurs. In the valleys the upper part of which (the rainfall being copious) is occupied by this evergreen forest, we find, immediately below, forests which in the dry season lose their leaves; and yet it is easy in this forest, to distinguish further, an inner and moister belt in which there is no teak, and an outer and less moist but warmer belt in which the teak is in its home.

Further eastward, in the dry climate of the Dakhan, another style of vegetation succeeds, in which the species of the "dry zone" prevail. They are not properly speaking forests, but thorny thickets, in which of course, when protected, trees grow up. But even here the influence of degrees of moisture in the soil can still be perceptibly traced. The dry stony hills are sparsely covered by a poor thorny scrub of different species from those which are found in the moister low lands along the rivers. Here, the well know babul (*Acacia arabica*) is the prevailing tree; it is a rather handsome and useful tree, widely distributed over almost all India, and found also in Africa and Arabia. In the southern dry zone this tree grows in the 'sailába' or low lands along rivers, but also elsewhere, where the black soil of the Dakhan, which has great water-retaining power, occurs.

In the Poona district the teak reaches its eastern limit, with a mean total rainfall of 30 inches in the year. The dry zone (with but little rain) has in this part of India a breadth of only some 100 miles (160 kilometrès), and to the north-east of the Bhima river, in hilly country with a somewhat moister climate, teak is again found.

It will be readily understood, that these different styles of forest pass one into the other by gradual changes, and that no sharp line of boundary between the zones of different degrees of moistness exists. It is, however, useful to establish such zones, as they much facilitate the understanding of the great variety which exists in the forest vegetation of India. It has been already mentioned that the white sandal (*Santalum album*) is very characteristic of the southern portion of the southern dry region. It is a small tree, the heart-wood of which is highly prized for its fragrance; while its solid, even, texture well adapts it for the purposes of the wood carver. The wood is in fact an important article of trade, and is exported in considerable quantities to China.

It is equally instructive to follow the changes that are observed in passing from the western moist zone to the "dry region" with uncertain rainfall, which includes a very considerable part of northern India. On the sea coast, Bombay (18° 54′ North Latitude) indicates the northern limit of the western moist zone. Further north, the rainfall rapidly diminishes. Surat has 42 inches, Broach 40, Kaira 33, and Ahmadabad only 30 inches. But the richly wooded valleys at the foot of the ghâts, have even here a much moister climate. They are occupied by valuable forest, in which the teak still shows rapid growth, and attains a considerable size. These are the so-called "Dangs," extending to 21° North Latitude nearly to the Taptee river, north-east from Surat. Also considerably further to the north a moist climate is met with, at some distance from the coast. Kaira (22° 45′ North Latitude), distant about 30 miles from the coast, lies in an open, woodless district, and has, as above stated, 33 inches of rain in the year. Godhra, 60 miles further east, and about 400 feet higher than Kaira, is surrounded by forest, which has been carefully preserved since 1870, and in the last 16—19 years the rainfall has reached 44 inches. In this region, the ghât-chain is lower, consisting of a broad irregular collection of hills, which gradually sinks in elevation till it merges in the extensive plateau of Málwá. It begins about 23 miles east of Godhra.

The district of which Godhra is the capital, is known by the name of "the Pánch Mahals." In the forest, teak is not very common, but the species still reaches the dimensions attained in the Dangs. Further north between 24° and 25° teak disappears, and with it a number of other trees, which in the moist, and moderately moist, zones are the associates of teak. Many of these latter species are again found in the forest tracts at the foot of the Himalayan range, where there once more a moister climate;

and some of these species may be met with almost up to the Indus in the latitude of 33° North. The teak itself, as already stated, has its northern limit between the 24° and 25° North Latitude.

In the northern "dry" zone, the southern portion of which extends from Rájputána to the 24th parallel of North Latitude, the forest vegetation is sparse and poor. As we pass out of the moist tracts that border on this dry zone to the south and east, the change is very striking: many species cease altogether, while others, which in the moist tracts were either wholly wanting or found only occasionally here and there, become dominant. The country, as might be expected under the circumstances, is sparsely wooded, and such forest as there is, is naturally more highly valued, than in districts better off in this respect. On this account in this part of the dry region we come across the rare spectacle of forests which have been protected by the inhabitants themselves, or by their chiefs, for centuries past—the object being sometimes to preserve the game, sometimes to supply firewood for the larger towns, or charcoal for iron-works, and especially to yield a reserve of fodder for cattle in years of drought. In many of these forests the *Anogeissus pendula* is the prevailing tree: it belongs to the order *Combretaceæ*, and in January when the seed ripens, its leaves turn red, calling to mind the autumn-tints of northern latitudes. This species is also found here and there in the neighbouring tracts of the 'moderate' zone: it is, however, especially characteristic of the northern dry zone. In the southern dry zone it is not found.

The "arid zone or region," where rain falls but seldom and with great irregularity, sometimes in winter, sometimes in summer, is surrounded by the northern "dry region," horse-shoe-wise. Here trees grow only on the sea-coast (*viz.*, a narrow strip of mangrove jungle on the lower Indus delta), and in the neighbourhood of the river Indus and its tributaries, as far as the moisture from the summer overflow, or lateral subsoil percolation extends. In this tract, the State forests of Sind, dependent for their existence entirely on the river, cover about 400,000 acres. They consist for the most part of the already mentioned babul (*Acacia arabica*). Going from the bank of the Indus through these forests towards the east, we soon enter the Indian desert, in which groups of trees and bushes can only be found, oasis-like, at rare intervals, on the moister spots. Only a few species occur, and most of them extend into the northern dry zone, while a few occur even in the southern. To these latter belongs the *Capparis aphylla*, a thorny leafless bush or small tree, with slender, green, branched, twigs, and covered in the hot season with a mass of scarlet (or

rather brick-red) flowers. It, like most of the species of the arid zone, is also at home in the deserts of Arabia, Egypt and Nubia. *Acacia Senegal*, a small, gnarled thorny tree, which in winter is covered with delicate (and sweet-scented) spikes of white and yellow flowers, is found as far west as the west coast of Africa about Senegal, and in India is confined to the "arid," and the northern "dry," zones. In its place, the southern dry zone has the *Acacia latronum*, (a tree with strong thorns,—often nearly 3 inches in length,—white and glossy like ivory,) and *Acacia planifrons*, called the "umbrella-thorn," because its crown, consisting of a mass of interlaced gnarled branches, thorns, and delicately pinnate leaves, grows on the top of the stems in the form of a flat dome or umbrella.

A change in character of the forest vegetation analogous to that described, is also observed on passing from the "moist" zone on the east and north of India, to the dry region. A long and narrow belt of forest is found along the foot of the Himalayas in a climate which is much moister than that of the woodless plains of Northern India lying in front. In this belt, up to 33° North Latitude, many species of tropical India are found, such as constitute a considerable portion of the forest in the peninsula and southern India. If a traveller proceeds from the middle portion of this belt-like district southwards, he must first traverse the woodless, Ganges valleys or plain,—woodless that is, now after many centuries of continued cultivation; but in uneven spots, where the original vegetation has escaped untouched, we still find many trees and bushes belonging to a comparatively dry climate. Southward again of the Ganges plain, we reach the mountain or hill districts of Central India, once more in a moister climate. Here in the less thickly populated tracts are extensive forests, which in their general character bear a considerable resemblance to those of the northern forest belt; although certain species which are not found at the foot of the Himalaya,—notably the teak, are here abundant,—indicating the southern latitude.

If again we start from the western portion of the northern forest belt, and proceed in a south-westerly direction, away from the mountains, we come to "the land of the five rivers," the Panjab, with a generally much diminished rainfall, and still further south to the desert of Rájputána and Sind. A distance of not more than 150 miles separates the forests of Dehra Dún at the foot of the Himalaya, (between the Ganges and the Jamna,) from the thorn jungle ("rakh" or "bír") of Hissár near the boundary of the Indian desert.

To the north of the sub-montane forest belt, rises the vast system of the Himalayan mountains. The exterior chains of hills, with a moist climate, have a rich forest vegetation, which, in the higher portions (over 7,000 feet) of the western districts, calls to mind that of Europe. But going northwards into the interior of the ranges, and approaching the rainless highlands of Tibet, the character of the vegetation—at the same elevation above the sea—changes. Many species, found in the outer ranges with a moist climate, disappear, and other species take their place; and even there the same species still occur, it is with a much slower growth. The deodar (*Cedrus Deodara*) which in the district about Simla (with a moist climate) attains a diameter of 2 feet in 80 years, in the dry climate of Kunáwar requires 200 years to reach the same size.

The relations between forest and rainfall in India are complex, but are also reciprocal. When the Government began some 30 years ago systematically to organize the conservation of the forests, the first object in view was to secure the continuous and permanent supply of the demand for wood and other forest produce, as well as to prevent the erosion of the mountain soil,—the washing away in the heavy rains of the loose soil, and the silting up of the beds of streams, and to put a stop to destructive floods which arose from landslips and other disasters on the mountain side.

At a later period, the Administration learned that, especially in districts with a dry climate, but even in moister districts, in exceptionally dry seasons, the growth of grass is richer, and more productive as a reserve of fodder for cattle, than on the barren open plain land. In years of famine and drought, the want of fodder and consequent mortality among cattle, are among the most serious calamities; and on this account the value of a well ordered system of forest conservancy, in such districts and at such crises, becomes simply incalculable.

That forest conservancy and afforestation, even on a large scale however, should have any considerable influence in increasing the annual rainfall, is a matter, which up to the most recent times, we have hardly dared seriously to hope.

But it is nevertheless true, that in the last few years facts have become known which certainly, so far, point to the conclusion that the conservation of forest in several localities has resulted in the increase of the mean annual rainfall. In that part of the Central Provinces which lies between the Nerbadda river and the plains of Nagpur and Raipur, and including the Sátpúra hills, the forest

has been protected for a series of years, and more particularly, it has happened, that a total area of about 600,000 acres has been successfully protected against the yearly fires during the hot dry season. As a result of this protection, many localities once showing great gaps in the forest, and others where large blanks and barren strips occurred, have now become filled up with a compact forest growth. In respect of these localities, Mr. H. F. Blanford says (page 12 of his Annual Report of the Meteorological Department of India, 1885-86)—we have for the seven stations named below, complete records of the rainfall from 1865 or 1867 up to the present time. The comparison of the annual average before and after 1875 may thus be represented :—

Station.	Annual average in inches.		Difference.
	Before 1875	After 1875.	
Badnúr (1867-75).	38·83 (1876—1885).	47·83	+ 9·00
Chhindwára (1865-75), ...	41·43	48·48	+ 7·05
Seoni, do., ...	52·07	54·76	+ 2·69
Mandla, (1867-75), ...	53·58	56·32	+ 2·74
Burha, do., ...	64·51	71·65	+ 7·14
Biláspur (1865-75), ...	41·85	54·81	+ 12·96
Raipur (1866-75), ...	51·59	54·41	+ 2·82
Annual average, ...	49·27	55·47	+ 6·20

40 years yearly observations at Jabalpur at the northern foot of the Sátpúras, and 37 years observations at Nagpur on the south side, are allowed a probable error (calculated at a 10 years' mean) of 5 per cent. If such be allowed for each of the seven stations above tabulated, that would amount to a deduction in the totals, of 2 or 3 inches. Further, it appears from a comparison of the rainfall figures of all India, that for the 10 years 1876-85, the mean annual fall was 0·66 inches greater than that observed in the 11 years for 1865—1875. It would also be justifiable to attribute about one-half of the difference ($\frac{1}{2}$ of 6·20 = 3·10 inches) to purely local causes. Mr. Blanford further adds that these results, do not of themselves afford a positive proof of the influence of forest conservation ; since it is possible that the earlier observations are less reliable than the later ones ; but he considers that these facts are at least to be accepted as a contribution to the already existing data which exist that such an influence may really be exercised.

To these conclusions of Mr. Blanford's I would add, that in the districts of the Central Provinces, "dahyá" cultivation (the system of cultivation by burning the forest), which formerly was the rule throughout these hills, has for the last 60 years, nearly altogether ceased: and that the operations undertaken to protect the forest against the annual fires in the hot season, were at first (in 1864) crowned with success only in a limited area, and were gradually extended over the whole area (600,000 acres) up to the year 1875.

A much longer series of observations from a much larger number of stations in this locality, as well as in other parts of India, where a regular conservation of the forest to a considerable extent, and especially where the annual fires have been continuously kept out, will be necessary, before a certain conclusion can be drawn. Above all things must the relations in question be studied and considered in connection with the circumstances of each locality. For example, it is not clear at the first glance, why (referring to the foregoing Table) Seoni and Mandla show a much smaller increase than other stations. But so much can already be stated, that if forest conservancy in the different provinces of the Indian Empire, is developed and extended in the way in which it has been begun, it will, in many cases, be the means of considerably alleviating the sufferings of the agricultural population, in years of drought and famine. Not only for the forest, but also for the land and its agricultural produce, is the rainfall a factor of the greatest importance. Notably, the dry regions and the neighbouring tracts of moderate rain supply, suffer from time to time by the irregularity or unseasonableness of the rainfall, or through occasional years of drought, which occur only too frequently. If even in a slight degree, forest conservancy and afforestation on a sufficient scale, could be made to influence the rainfall in the way of increase, in unfavourable years, the advantage to the land and its people would be incalculable.

INDIAN SEEDS IN NEW ZEALAND.

On the 19th of February, 1885, I sent to New Zealand the following seeds:—

Shisham, ...	... 140,000
Wild olive, ...	... 87,000
Boxwood, ...	... 71,000
Chir, ...	.. 52,000

From Deoban were also sent a quantity of deodar seeds, *Pinus excelsa*, and *Abies Smithiana*.

A large number of the deciduous trees came up, but if I am right they were afterwards killed by frost.

Of the chir (*Pinus longifolia*) there are now about 20,000 trees alive, and from 3 to 15 inches high in the nursery (Hasenberg).

Pinus excelsa seeds (without name attached) have done moderately well, there being about 2,000 trees of 4 inches height.

Abies Smithiana not come up, in fact the seeds appear to be *Pinus excelsa*.

Cedrus Deodara. None have come up from both year's consignments. The cones last sent appear not to have been fertilized, as stated by Professor Kirk, F.L.S. The cones were packed in paper and rags, which were quite rotten when the tins were opened. A further supply of properly fertilized cones, packed if possible in their own needles (leaves), and carefully picked from the trees, and not collected from those shed on the ground, is desired, and the cones should be pulled before too ripe.

The plantation is at Auckland, near Wellington, on the North Island.

DEHRA DUN,
3rd December, 1887. } H. WARTH.

NITROGEN GAS IN SWAMPS.

ABOUT five miles south-east from Dehra Dún station is a swamp, from which a stream issues, and forms one of the numerous sources of the Suswa river in the Dehra Dún.

The swamp is lined with forest trees, amongst which occur *Quercus incana*, and also bushes of wild coffee and numerous wild citrons. From the bottom of the swamp gas bubbles rise here and there, and when the mud is disturbed by thrusting a stick through it, gas invariably follows. I would long have liked to observe and obtain marsh gas, CH_4, from a swamp, and so I collected several glass flasks of this gas. I soon found however that, as on many previous occasions, I had again failed to obtain true marsh gas. The gas would not burn, neither did it maintain combustion. I thought it might be carbon-dioxide, but on shaking it with much quick-lime there was no absorption ; nor did I obtain a precipitate with dilute lime water. Further, after holding a bottle full of the gas mouth downwards, over another bottle with the mouth upwards, and filled with air, no intermixture took place. The lower bottle

remained full of air, in which a burning chip of wood continued to burn, the upper bottle retained the gas, which extinguished a chip of wood instantly. The gas must therefore be lighter than air. These tests, though only made roughly in camp, convinced me that the gas rising from the swamp is nitrogen, which might contain at the most a mere trace of oxygen.

It would be interesting if such gases were examined elsewhere, and especially a notice of pure marsh gas would be welcome. The gas in the Dún was obtained in November 1887.

H. W.

THE HUMANE SPORTSMAN.

In looking over a German book of sport, entitled "Das Waidwerk," the following introductory verses attracted my attention, and as they express concisely the sentiments of all true sportsmen, I thought they might be welcomed at this season of the year, when many "shooters" are on the loose. I send the original for your comparison.

Das ist des Jägers Ehrenschild
Dass er beschützt und hegt sein Wild,
Waldmännisch jagt, wie sich's gehört
Den Schöpfer in Geschopfe ehrt!

Das Kriegsgeschoss der Hass regiert,
Die lieb zum Wild den Stutzenführt:
Drum denk' bei Deinem täglich Brod
Ob auch Dein Wild nicht leidet noth.

Behüt's vor Mensch und Thier zumal!
Verkürze ihm die Todesqual!
Sei aussen rauh, doch innen mild,
Dann bleibet blank Dein Ehren schild!

The sportsman's only free from blame
When he preserves and shields the game,
Declines to slay by unfair means
And ever towards mercy leans!

Hate guides the bullet's flight in war,
Let kindness be the sportsman's law:
You, when you plan the creature's good
Revere its Maker as you should.

Protect 'gainst man and animal!
Let the death shot be merciful!
Thus shall the sportsman's name remain
Without a spot, without a stain!

EYED HOOKS.

FOREST FIRES IN GREECE.

A friend who steamed through the Greek Islands in August last, informs us that he saw forest fires blazing in all directions on the hill sides, in the scrub forest which covers them. Marsh in 'Man and Nature' states that the Mediterranean regions, once the most fertile in the world, are now in great measure reduced to unproductive wastes, and no wonder if this barbarism is allowed!

JJ. Reviews.

BAMONPOKRI WORKING PLAN.*

This is a plan for a small area in the Darjeeling District, Bengal, consisting of 1,372 acres of mixed sál forest at the lower extremity of a spur of the Himalayas. The forest is mainly composed of two plateaux sloping gently towards the south, the upper plateau being about 1,500 feet, and the lower 900 feet, above sea level, the two being separated by a steep slope, and bounded on either side by precipitous ground descending to the broad stony beds of two small streams. The average rainfall is about 115 inches; November, December, January and February being the four rainless months. The principal trees are *Shorea robusta* (forming less than 8 per cent. of the crop), *Schima Wallichii*, *Terminalia tomentosa* and *Cedrela Toona*. The crop is irregular, but forms a more or less complete canopy, and in Block I, which is the oldest of the five blocks formed, the average number of trees of one foot in diameter and over, exceeds 40 per acre. The more accessible portions have been deprived of their large trees by the permit system, and the southern portion, which was formerly cleared for cultivation, has been planted up with teak and toon. This forest is called on to supply timber for tea-boxes and fuel, the demand being greatly in excess of its capability. It is anticipated that, as the use of coal increases, the principal demand will eventually be for building timber and for tea-boxes.

The plan consists of five Chapters, containing—I., an account of the administrative circumstances, physical and economic conditions of the forest; II., detailed description of compartments; III., the working plan; IV., the execution of the working plan; V., plan for working certain areas excluded from the main plan, and of appendices connected with the calculation of the yield.

Chapter I. is concise and to the point. The descriptions of compartments in Chapter II. seem somewhat meagre and lacking

* By Messrs. Chester and French.

in some essential particulars. Thus in many of them no mention is made of reproduction, and in others the seedlings are said to be few or many without mention, as a rule, of the kind or quality of the seedlings referred to. The compartments in Block V. are mainly plantations, and as their age is probably well known, it certainly deserved mention, whilst under the general description of the forest the number of acres planted up should have been shown, and a short history of their formation given. There seems also no good reason for following the French system of numbering compartments, instead of employing Arabic numbers as prescribed by the Indian Forest Code. It would have been very useful if a summary description of each block had been drawn up, as this would, in a certain measure, explain their *raison d'être*.

Of the 1,372 acres, 1,050 have been formed into the Bamonpokri Working Circle, which includes 20 acres of unstocked land, 104 acres of steep slopes have been formed into the Pankahari Working Circle, whilst the remainder consists of scarps and river beds.

The plan for the Bamonpokri Working Circle prescribes the application of the method of natural regeneration and thinnings, and the forest seems a suitable one for a trial of this method in India, being small in extent, free of rights, situated on favorable ground, and with natural reproduction almost assured, although we could have wished it contained fewer species, and was more regularly constituted; however, the sacrifice of immature timber usually entailed by the process of conversion will, in this instance, be considerably lessened by the fact that large areas are at present occupied by saplings and poles and by young plantations.

Very few data were available for the purpose of fixing the rotation, and it seems regrettable that no provision has been made in the plan for the collection of such information in the future, as it would be of great use hereafter, when the plan is revised, to have some more definite ideas regarding the rate of growth of the principal species. The discussion in para. 26 as to what will take place 125 years hence, might very well have been omitted, as it is impossible for poor fragile man to look forward profitably to such a remote future, and to lay down the law for his great-great-grandchildren. The rotation of 125 years has been selected chiefly in favor of sál, which it is believed requires about this time to attain a girth of over 6 feet. It has been divided into five periods of 25 years each, and the circle into five periodic blocks of equal productiveness.

We are sorry to be unable to approve of one of the most im-

portant parts of the plan, *viz.*, the calculation of the annual capability. The method adopted was in the words of the plan as follows :—

"After a careful study of the compartments and formation of the first periodic block, an enumeration of the trees forming the crop over the whole of this block, compartment by compartment, was executed. The diameter of the trees was measured at breast height, and every tree classed according to species and according to diameter.

"The diameter classes were 1·0 foot, 1·2 feet, &c., rising in fifths of a foot, trees between 0·9 and 1·1 feet in diameter being classed as of 1·0 foot, and so on. Trees under 0·9 foot in diameter were omitted, and considered as part of the advance growth. The above figures having been obtained for each compartment, an abstract was made for the block. For each of the species the following calculation was made. The square of the diameter of the class was multiplied by the number of trees in that class, and the sum of these products was divided by the sum of the trees; the square root of the result gave the diameter of the tree of average volume of that species.

"This calculation, of course, assumes that the tree of that species of the average diameter is also the tree of average volume.

"Having made this calculation for each of the 17 species that occur in considerable numbers in this block, a type tree of each of these species, of this average diameter, and having, as far as the eye could judge, an average form, was selected and felled, the bole was cubed in short sections, generally of 6 feet length, and the branch-wood was cut into firewood, allowed to dry for two months and weighed. For the trees forming less than one per cent. of the crop, that is, trees of other species than the 17 above referred to, three groups were formed, based on the general size of the trees, trees of one group were considered as of one species, and a similar calculation led to the selection of a type tree for each group."

The diameter classes (20 in all) appear too numerous, and it would seem quite sufficient if the classes rose by half a foot instead of by a fifth, and in this case a complete enumeration of the whole forest could easily have been made in a few weeks. The results of the enumeration made in Block I., which alone was valued, are given in the bulk in Appendix I., but we think that the valuation of each compartment should have been recorded separately, and that these compartmental divisions have been insufficiently utilized.

It does not seem quite correct to assume that the tree of average diameter is also the tree of average volume. For example, suppose that in an acre of regular forest of one species we have the following stock :—

1 No. of trees.	2 Average height.	3 Average diameter.	4 Square of diameter.	Product of 1 × 4.	Cubic contents.	
	feet.	feet.	sq. feet.		c. ft.	
32	50	1	1	32	1,257	The cubic contents are calculated for simplicity's sake on the supposition that each tree is a perfect cylinder, and by the formula $D^2 \times \cdot 7854 \times L$ = cubic content.
12	80	2	4	48	3,016	
12	100	3	9	108	8,482	
3	120	4	16	48	4,524	
59	...	...	...	236	17,279	

$\therefore \frac{236}{59} = 4$, and $\sqrt{4} = 2$ = average diameter

cubic contents of 59 trees 2 feet in diameter and 80 feet high,	... =	14,928
Difference,	... =	2,351

or an error of nearly 14 per cent.

Therefore, even if a type tree could be correctly chosen, the calculation might be considerably out, but we maintain that it is humanly impossible to select such a tree in such a forest, and that on this account the calculation should be regarded with still greater distrust. We are aware that it is customary in the regular forests of France to select type trees for this purpose, but then a type is taken for each diameter class, and such a course is only pursued in forests long subject to the method of natural regeneration and thinnings, and not in those under jardinage.

The annual capability for the first period is fixed at 12,000 maunds, a figure obtained by dividing the growing stock in the first block by 30, which is to be the duration of the first period instead of the ordinary one of 25 years. This is to allow for the conditions of growth in the I. and II. blocks, and it is regrettable that a complete enumeration of such a small area, as this forest covers, was not made, for then the working plans officer could have better judged as to the advisability of this lengthened first period, and would be in a better position to prevent great differences in the annual capability when passing from one period to the next. It has, however, been prudently resolved to cut only 9,000 out of the 12,000 maunds, thus keeping a reserve of one-fourth. 'Tax,' the word employed to express the amount to be cut out in the principal fellings, is evidently a literal translation of the French *taux*. The term is not a happy one, and is not associated in its usual sense with pleasant memories to most Englishmen. It

does not appear in the list of Forest Technical Terms adopted by the Forest Conference of 1886.

The Table of yield of the principal fellings should have given the expected yield from each compartment, as such figures could have been utilized as a check on the actual outturn.

Table B, the special plan for the first period, consists of a summary description of the crop, and prescribes the cuttings to be made, regeneration, jardinage or improvement fellings, cleanings, thinnings and creeper-cutting, and seems to be just what is required. Whilst regeneration fellings are in progress in Block I, jardinage fellings of dry trees are to be made elsewhere, and this, judging from the state of the crops, is probably the correct treatment, although in an ordinary type of forest under conversion, there would be considerable loss in material by restricting fellings over three-fourths of the area to dry trees only. Table D gives the order and areas of the jardinage and improvement cuttings during the first period.

Chapter IV. contains useful instructions as to how the operations prescribed by the plan are to be carried out, the conditions under which the produce is to be removed, and the mode of controlling the outturn. It is prescribed as a check that an enumeration of the growing stock in Block I. be made in 1897-98, which is of course all right for such a small area, but such a system would not be possible as a rule in India, as it means the enumeration of the stock over one-fourth of the whole forest once in ten years.

The working plan would have been improved if a chapter had been devoted to financial results, and as everything is saleable, a rough estimate, we should imagine, could easily have been framed.

If the plan is passed, Messrs. Chester and French will, we fancy, be the first officers to introduce the French system *par excellence* into India, and we hope it will be successfully carried out. The forest is in the direct charge of a ranger, who has, in addition, the care of two smaller forests a short distance off, or a charge of less than 5,000 acres, so that there is every chance of proper attention being paid to the execution of the plan.

THE FORESTS OF JAMAICA.*

It may be taken, we think, as a compliment to India, that her Forest officers are often selected to advise Colonial Governments as to the management of their forest estates. No doubt, the advice

* Report upon the Forests of Jamaica, by E. D. M. Hooper, Esq. London, Waterlow and Sons, 1886.

may not be always followed, but the reports published, and the knowledge that forestry was attracting attention, cannot but do good. In late years Indian Forest officers have been called upon officially to report upon forests in various colonies; New Zealand, Ceylon, Mauritius, Cyprus and now the West India Islands, and especially Jamaica. Mr. Hooper's visit to the West Indies was carried out during the period of a recent furlough, and after a lengthy tour homewards *viâ* Australia, Japan and the United States, during which he specially studied many varied forest conditions, about which we may hope he will some day give us his experiences. Throughout his tour Mr. Hooper was accompanied by his photographic camera, and the collection of photographs which he made will be found very interesting to any one who, like the present writer, has been privileged to see it. Mr. Hooper received, we believe, every help from Sir Henry Norman, once Member of the Supreme Council in India, and now Governor of Jamaica, and from Mr. Morris, then chief Government Botanist in Jamaica, and now Assistant Director of Kew Gardens.

Jamaica was discovered by Columbus in 1494, and till 1655 the island remained Spanish. Since then it has been a British Colony. Its area is, according to 'Whitaker,' 4,193 square miles. Mr. Hooper in one place gives 2,110,678 acres, which is 3,298 square miles, and in another gives the areas of the three counties as—

Surrey,	... 766	sq. miles,	a rather serious discrepancy which requires explanation.
Middlesex,	... 1,920	„ „	
Cornwall,	... 1,504	„ „	
Total,	... 4,190	„ „	

The geology of the island seems to have been well worked out. Mr. Hooper says: "the island appears to have been under formation in miocene times by coral insects on a previous eocene foundation, so to speak, of sandstones, conglomerates, &c. Due to gradual subsidence, the depth of limestone formed by the insects reaches up to 500 feet, while in later post-pliocene times a further deposit of 2,000 feet was made. Eventually, Jamaica emerged by igneous action, and the Blue Mountains assumed their present position, forcing up and exposing the stratified rocks they burst through, and by the action of heat altering their composition."

The rainfall varies so much according to the side of the island, that Mr. Hooper gives four regions—

1.	North Eastern	—mean annual average	...	91·04	inches.
2.	Northern	„ „ „	...	57·34	„
3.	West Central	„ „ „	...	70·73	„
4.	Southern	„ „ „	...	50·53	„

At the Government Cinchona Plantations at 4,850 feet, the rainfall, however, reaches 180 inches, while at Palisadoes plantation in the south it falls as low as 9 inches. Rain falls, usually, in all months of the year, but the chief rainy months are those called the 'seasons,' which obtain their rainfall with the trade winds—May and October. The temperature varies, of course, according to elevation, but taking for examples Kingston on the coast, and the Cinchona Plantations at nearly 5,000 feet, we have—

	Maximum.	Minimum.	Mean.
Kingston, ...	... 91·2	67·2	79 2
Cinchona, ...	... 72·6	54·1	63·3

On the whole, however, the temperature at any given place seems to be very constant.

Forest does not, it appears, occupy any particular parts of the island, for, were it not for human agency, the island, such is its fertility and such the favourableness of its climate, would soon relapse entirely again into forest, and the only signs of the former presence of man would be the occasional prevalence of introduced species like the logwood, bamboo and mango.

Mr. Hooper divides the forest growth into—

1. Savannah growth.
2. Limestone hill forest.
3. Port Royal mountain.
4. Blue mountains, lower.
5. „ „ high.

The *Savannah growth* is quite small, scarcely exceeding 20 feet in height, and mostly composed of 'cashaw' (*Prosopis juliflora*) and 'logwood' (*Hæmatoxylon campeachianum*). There are also trees of 'Braziletto' (*Cæsalpinia braziliensis*), 'bastard cedar' (*Guazuma tomentosa*), 'lignum vitæ' (*Guiacum officinale*), 'fustic' (*Maclura tinctoria*) with others, and a few mahogany. The *limestone hill forest* is chiefly characterised by the 'Breadnut' (*Brosimum alicastram*), associated with which are the wild tamarind, the 'Circassian bean' (*Adenanthera*) and others, with a few mahogany in inaccessible places.

In the *Port Royal Mountains* above 2,000 feet, the Breadnut is replaced by 'mahoe' (*Paritium elatum*), and above 3,000 feet the 'Santa Maria' (*Calophyllum Calaba*), 'Rodwood' (*Eugenia laxcolata*), &c., appear with the shrubby growth which follows hill-side clearances.

The *Blue Mountains* vegetation, is less important than that on the limestone ranges. Low down the 'Ceiba cotton trees' (*Eriodendron anfractuosum*) are conspicuous, higher up the 'cedar tree'

(*Cedrela odorata*) is noticeable, and higher again the 'juniper' (*Juniperus bermudiana*), while on the extreme summit 'Yacca' (*Podocarpus coriaceus*) and 'soapwood' (*Clethra tiniifolia*) are almost the only trees.

The *timbers* of Jamaica have mostly hard woods with a few soft wooded species, and the list of them given by Mr. Hooper is very interesting and useful, especially as it tells us the botanical names for many West Indian trees, whose woods we are accustomed to hear spoken of only under a native or semi-English name. The chief valuable wood is the 'cedar' (*Cedrela odorata*), a wood very like our 'toon,' the (*C. Toona*), and the Australian cedar (*C. australis*). It is largely used for furniture. 'Mahogany' is the next most important wood, naturally, but it is nowhere very common. 'Logwood' is perhaps the most valuable trade wood, and of it an average yearly amount of nearly 54,000 tons is exported, the price varying very greatly. Last year it fetched £5 10*s.* per ton. 'Fustic' is another dye wood which demands attention, and Mr. Hooper mentions, besides, the mango and bamboo, both introductions, and the juniper, as trees which require attention from foresters.

The area of Crown land is said to be 75,000 acres under the complete control of Government, and the lands are found chiefly on the Blue Mountains and in the limestone country; and it is naturally out of this land that reserved forests would be selected. Mr. Hooper very rightly insists on the introduction of forest conservancy being gradually attempted only, and advocates it mainly "on the practical grounds that there is an absolute necessity for regulating the water supply in the Eastern District; also for protecting the lowlands from the torrential flow of the rivers; and on the south side of the island for general protection against the terrible north winds, which occasion so much damage and danger to property and life." He does not, however, think that it will pay its way for some time to come. Shortly described, his proposals are as follows:—

1. To reserve the highlands of the Blue Mountains, escheating all land liable to forfeiture, arranging amicably with neighbouring proprietors for the surrender of such back-lands useless to them that they may be willing to part with, and obtaining all lands in private hands on the ridge or near it.
2. To demarcate and survey the reserved forest so formed, and protect it against fire and theft and trespass.
3. To retain as forest reserves all blocks of Crown lands on the limestone formation that exceed 2,000 acres in extent.
4. To rigidly enforce the conditions in the present cinchona leases, and in future leases to provide for the protection

of hill sides by not allowing more than 3 acres to be cleared at one spot at a time.

The first three seem simple and obvious recommendations, the last, to one who does not personally know Jamaica, seems a little difficult to carry out, and likely to cause some dissatisfaction.

He advises the entertainment of a forest staff of—

1 Executive Forest officer, at £250 to £500 per year,
2 Bailiffs, at £30 per year,
5 Forest Guards, at 1*s.* per day,

the whole to be under a controlling officer, who, he advises, should be jointly maintained by the various West Indian Colonial Governments, with head quarters in Jamaica, or if this is not feasible, under a Conservator of Forests for Jamaica alone.

We are very glad to see that he does not propose any immediate legislation, and we are glad to read his sensible remarks when he advises that only later on, when the requirements of the forests and their management are fully ascertained, should legislation be resorted to. There is nothing, we should think, so likely to choke off a Government from undertaking forest conservancy than its being told that preliminary legislation, giving it extensive powers, and raising extensive enquiries, is a first necessity. In such a case as Jamaica, the simplest plan is, in our opinion, first to ascertain what part of the Crown lands which are of value as forest, can be obtained for reservation free of servitudes, and to set that area apart. If it is insufficient, and private lands have to be taken up, or Crown lands freed from servitudes, a simple Act to give Government powers to do so should suffice. By then too it should be known what special police measures have to be provided for, and these can be arranged accordingly.

J. S. G.

THE FORESTS OF ST. VINCENT.*

ST. VINCENT is a small island in the West Indies, 80 miles west of Barbadoes. It has, according to Mr. Hooper, only an area of 85,000 acres (133 square miles) in all; but we may state that 'Whitaker' gives 140 square miles. It was discovered in 1498, and was definitely proclaimed a colony of the British Crown in 1764. The island is volcanic, and the hills which rise to about 4,000 feet are chiefly formed of igneous rocks, such as porphyry and basalt. It has, however, on the south and east broad well defined valleys, chiefly used for sugar cultivation, and some use-

* Report upon the Forests of St Vincent, by E. D. M. Hooper, Esq., Indian Forest Department. London, Waterlow and Sons, 1886.

ful rivers. The climate is equable, the average being 85° Fahrenheit by day and 75° by night, the maxima and minima rising and falling to only 90° and 68°. The rainfall seems to average about 100 inches, the record of the Penniston Estate in the Buccament valley given by Mr. Hooper showing an average of 108 inches for the years 1882 to 1885 inclusive. There is rain in all months, but there is less in what is called the 'dry' season, *viz.*, February, March and April, when the average is 16 inches.

The forests of St. Vincent exist only in the hill country, and to a small extent on the coast, and even there in the adjoining hills and valleys they occupy an area of about 30,000 acres, or 35 per cent. of the island. Mr. Hooper divides them into the following groups :—

1. *Coast forests*—noticeable for the growth of 'white cedar' (*Bignonia Leucoxylon*) and the 'Gru Gru' palm (*Acroconica sclerocarpa*). The 'Manchincel' (*Hippomane Mancinella*), the 'seaside grape' (*Coccoloba cuifera*), the 'Turpentine tree' or 'Gomea' (*Bursera gummifera*) and the 'Almond' (*Terminalia Catappa*) also occur. This class of forests occupies the belt up to about 300 feet, and the areas are much used for grazing purposes.

2. *Slopes forest*—from about 300 feet up to 2,000 feet in elevation, and containing the chief timbers 'Greenheart,' (Mr. Hooper does not tell us clearly if this is the same tree as the Greenheart which is used in our dockyards, and which we suppose is *Nectandra Rodiæi*), 'Locust' (*Hymenæa Cousbaril*), 'Galba' (*Calophyllum*) and 'Angincel' (*Audira inermis*) are the principal trees. Palms, canes, wild pine-apples, Heliconias, tree ferns and vines, the usual mixture found in moist evergreen tropical forests, constitute the thick undergrowth, while the bread fruit tree has regularly established itself in sheltered spots.

3. *Summit forest*—occupying the tops of the mountains and economically of little value. Botanically, the summit flora must be very interesting, but the trees are mostly stunted and twisted by the wind, and burnt patches, the results of volcanic eruptions are not uncommon.

4. *Northern coast forest*—occupying a small area only, and marked by the presence of *Bursera gummifera*, the 'Loblolly' (*Sciadophyllum*) and the 'Wild Mammee' shrub (*Portlandia*).

Mr. Hooper gives an interesting account of the system of negro cultivation which is ruining the forests. It seems not very dissimilar from our Indian 'jhum,' 'kumri,' 'dahya,' 'toungya,' &c. He goes on to explain that the most important reasons for recommending the maintenance of forest on the hills are the desirability

of protecting the water supply and preventing torrents; the importance of keeping up forest vegetation to maintain moisture in the atmosphere in the event of drought; and the advisability of using it as a shelter against winds.

His proposals are very simple. They are chiefly, the permanent reservation of the forests of the main ridge down to an altitude of 1,000 feet, so far as land is available and at the disposition of Government. He does not advocate the reservation of other and scattered blocks of Crown lands, being of opinion that these will be required for extension of cultivation, and that possibly even some parts of the forest above 1,000 feet may have to be made available for the same purpose. Without knowledge of the localities and the circumstances of the island, it is not possible for us to criticize too closely these recommendations; but we wish to express our pleasure at seeing that they are clear and to the point, are easy to understand and easy to carry out, even by an unprofessional forester, for the island is not likely to be able to afford to pay highly for its forest management.

We would draw attention to Mr. Hooper's account of the growth of teak in St. Vincent, one tree cut showing an average growth of 6·6 rings per inch of radius. He recommends its being used with mahogany both by the Government and by the owners of private estates for planting purposes, and we hope to hear that his advice has been followed.

Looking to the general condition of a tropical little island like St. Vincent, we certainly think that Mr. Hooper is quite right in considering that any elaborate scheme of forestry into reserves and the rest of it would be a mistake. To protect the water supply, prevent torrents and increase the humidity of the atmosphere, little beyond the protection of the hill tops and slopes can be done, and if this is done, enough is done for the forests of the island. Fuel cannot be largely required where the temperature is never less than 68° F.; timber can be procured with ease, from the grand forest of the mainland of Brazil, Guiana and Central America, and we know of no other forest requirements of any great importance. But we do think that if forest work is attempted on the hill area, it should be thorough, and the area kept up should be as speedily as possible brought into the best possible condition, so as to be generally capable of being worked on a system, and the forest made to supply as far as possible the requirements, not so much of the officials and traders and planters on the coast, but of the lower class population of the island.

J. S. G.

III Notes, Queries and Extracts.

Influence of Forests on Rainfall.*—Nearly connected with the question just discussed, is that of the influence exerted by forests on the rainfall; a question of the highest economic importance, to which renewed attention has recently been drawn by the eminent physical geographer, M. Woeikoff. In an instructive paper, originally communicated to Petermann's Metteilungen,† and subsequently published in translation in the Quarterly Journal of the Royal Meteorological Society, M. Woeikoff appeals emphatically to the evidence afforded by the Indian rainfall registers, in support of his contention that the action of forests is to increase the rainfall of a country. His appeal is directed chiefly to the contrast afforded by the Assam rainfall with that of the Gangetic valley plain, in about the same latitude, and the same distance from the sea; and he apparently attributes the great difference displayed by these two provinces, wholly or mainly to the fact that, while the former is extensively covered with forest, the latter, up to the Terai, is a broad sheet of field cultivation.

From what has been said in the foregoing pages, of the geographical circumstances affecting rainfall in India, and of the conditions prevailing in Assam, it will be obvious that I am far from coinciding in such a view. Without denying or even questioning the effect of forests as one element of the result, the conclusion thus formulated seems to me far too sweeping. M. Woeikoff considers, and I think rightly, the action of forests in enhancing the rainfall to be two-fold. Firstly, they help to store the water by protecting the soil and so keep up a constant evaporation; and, secondly, by checking and obstructing the movement of the wind, they prevent the evaporated vapour being carried away, and tend to produce that calm state of the atmosphere that is favourable to ascending currents and local precipitation. But swamps, such as occupy large tracts of the Assam valley, and the numerous broad river channels that intersect it, must contribute a not unimportant quota to the vapour constituent of the local atmosphere; and the

* Indian Meteorological Memoirs, Vol. III., Part II., The Rainfall of India. By H. F. Blanford, Esq., F.R S., Meteorological Reporter to the Govt. of India.

† *Op. cit.* 1885.

comparative stagnation of the air in the Assam valleys, and the exclusion of those dry westerly winds, which play so important a part in the meteorology of the Gangetic plain, are certainly due, in far larger measure, to the fencing in of the Assam valley by the Patkoi, Naga, Khasi, and Garo hills, and, as regards Upper Assam, to the interception of westerly currents by the mid-valley obstruction of the Mekhir hills, than to any retardation of wind movement that can be effected by the forests. Furthermore, the action of the surrounding hills, in setting up a diurnal convection of the humid atmosphere, and its consequent dynamic cooling and precipitation, an action which also takes place in the much less humid hill tracts of the peninsula, is a very important factor in the causes which contribute to produce the heavy spring rainfall of Assam ; a precipitation not very greatly inferior to that of the summer monsoon. The other, or passive, effect of hills in enhancing rainfall, *viz.*, the forced ascent of horizontal air currents, is less important in Upper Assam, (the tract more particularly referred to by M. Woeikoff,) although exhibited by the southern face of the Khasi hills, overlooking Sylhet, in a degree without parallel elsewhere in the world. But to the other causes, above specified, must certainly be attributed by far the larger part of that prevailing high humidity and copious rainfall, which foster the exuberant vegetation of the province, rendering it in the rich variety of its flora and its prolific insect life, comparable with the teeming productiveness of the Malay region.

The difficulty so conspicuously illustrated in the foregoing example, *viz.*, of disentangling the combined effects of a number of causes, all favourable to increased rainfall or the reverse, is one which renders it almost hopeless to seek for decisive evidence of the influence of forests, by any comparison of the rainfall of different provinces, or of areas sufficiently large to display the contrasted effects in a striking and convincing manner. The best, and perhaps, only satisfactory kind of evidence, were it obtainable, would be the comparison of the rainfall of one and the same tract, (one of at least some hundreds of square miles in extent,) for many years ; first while covered with forest, and again for many years after clearing. It is, however, not until a tract of virgin forest has been brought under the destructive operation of civilizing agencies that, as a general rule, any attempt is made to record its rainfall ; when, therefore, the conditions necessary to obtain one term of the comparison are rapidly disappearing. The reversal of this order of things, the conversion of bare, or at least partially wasted, tracts into protected forest, is one, however, of which India already fur-

nishes some examples, and with progress of forest protection may yet furnish more ; and if due advantage be taken of these as they present themselves, it may yet be possible to obtain rainfall data which may afford valuable, and indeed practically conclusive, evidence on the point in question ; even if not fulfilling, in all respects, the rigorous conditions of the logical method of differences.

One instance of the kind, on a scale large enough for all reasonable demand, has lately been brought to my notice by Mr. Ribbentrop, and has been quoted in my Report on the Administration of the Meteorological Department in 1885-1886 ; and, despite some shortcomings in the due verification of the data, shortcomings which it is now impossible to make good, it will probably, in the course of some years, as nearly fulfil the conditions of a test case, as we are likely to secure in an experiment of such magnitude. In some respects, indeed, the circumstances of this case are unusually favourable. The vicissitudes of the rainfall of the Central Provinces are smaller, proportionally, than those of any other province of an equally moderate average ; and of the 22 stations, the rainfall registers of which will be brought in evidence, not less than 10 are regular meteorological observatories, working under the Meteorological Department of the Government of India.

The region, referred to in the first part of my Memoir on the Rainfall of India, as the Central Provinces, South, has been described "as a hilly and jungle-clad country, including some extensive fertile plains, especially that which surrounds Raipur." The northern portion consists of the range of broken table-lands and hills, here spoken of as the Satpuras, and these are largely clothed with forest. According to the most recent report of the Officiating Inspector General of Forests, the area of forest in the Central Provinces is estimated at 54,600 square miles, of which about nine-tenths are in or to the south of the Satpura range. The area of the Central Provinces, South, has been given, at page 12, as 61,000 square miles. Hence about five-sixths of the whole are under forest. Now, prior to the year 1875, these forests were systematically wasted, by the destructive method of cultivation, practised by the hill tribes of Gondwána, as of other wild tracts in India and Burma. It is known under various local names, such as *kumri*, or, in the Central Provinces, *dáhya* cultivation, and is thus described by Dr. Brandis: "A few acres of forest are felled one year, the wood is burnt and a crop of grain raised on the clearing ; the next year this is abandoned, a fresh piece of forest is felled elsewhere, a crop is raised, and it too is abandoned in its turn ; and so on, a fresh clearing being made every year."

It will be readily understood how, under such a system, in the course of some years, extensive forests may be devastated, even by a sparse hill population of nomad habits. And, accordingly, in the introduction to the Central Provinces Gazetteer, published in 1870, Mr. C. Grant speaks of the state of the forests in the following terms :—

"The tree forests of the Central Provinces have, however, been so much exhausted, mainly owing to the destructive *dáhya* system of cultivation practised by the hill tribes, that, except in one or two localities, the labours of the Forest Officers will, for many years, be limited to guarding against further damage, and thus allowing the forests to recover thmselves by rest. By far the greater part of the uncultivated lands, belonging to Government, are stony wastes, incapable of producing a strong straight growth of timber."

In 1875, the suppression of *dáhya* cultivation was taken systematically in hand ; and in the course of a few years, with such success, that Mr. Ribbentrop writes in 1886 :—

"My attention was directed, during a recent visit to the Central Provinces, to the extensive growth of young forests, in areas formerly under *kumri* cultivation. Ten or fifteen years ago, such temporary cultivation was practised throughout the country, and thousands of square miles were thereby laid barren, year after year. Since then, this method of cultivation was stopped, and, though a great part of the area affected was subject to annual fires, a more or less dense forest growth has sprung up. I concluded that this must have had an influence on the rainfall, sufficiently appreciable to be gauged by meteorological records. The results, gathered from such records, are beyond exception, and show that, with the exception of stations situated in the cultivated valley of the Nerbudda, a steady increase of rainfall has taken place during the last ten years, and, as might be expected, especially during the last period of five years."

In dealing with the evidence of the rainfall registers, I shall in the first place, compare the averages of the nine or, in some cases, ten or eleven years, ending with 1875, (the year in which the suppression of the *dáhya* cultivation was taken in hand,) with those of the ten years subsequent, 1876—1885 ; and this I shall do, separately, for the stations within the area immediately affected by the forest preservation, and those at a greater or less distance therefrom. These latter are Saugor and Damoh, the forests near which have not been frequented by *dáhya* cultivators, or which are surrounded by Native States in which no change of system has been attempted, *viz.*, Jubbulpore, Narsinghpur, Hoshangabad and Khandwa, in the fertile and highly cultivated valley of the Nerbudda, and where the tendency of late years has been towards an extension

of permanent cultivation; and Raipur in the centre of the great wheat-growing district of Chattisgarh.

Comparison of the average rainfall of nine to eleven years of dáhya *cultivation with that of ten years of protected forests.*

A—In affected areas.

Stations.	*Forests unprotected.* Period.	Rainfall. Inches.	*Forests protected.* Period.	Rainfall. Inches.	Increase. Inches.
Badnur, ...	1867—75	39·83	1876—85	47·83	+ 8·00
Chhindwára, ...	1865—75	41·43	1876—85	48·48	+ 7·05
Seoni, ...	1865—75	52 07	1876—85	54·76	+ 2·69
Mandla, ...	1867—75	53·58	1876—85	56·32	+ 2·74
Burha, ...	1867—75	64·51	1876—85	71·65	+ 7·14
Biláspur, ...	1865—75	41·85	1876—85	54·81	+12·96
Sambalpur, ...	1867—75	54·80	1876—85	67·93	+13·13
Dhamtari, ...	1867—75	48 83	1876—85	46·90	— 1·93
Bhandára, ...	1867—75	49 90	1876—85	57·79	+ 7·89
Nágpur, ...	1866—75	41 54	1876—85	51·85	+10 31
Wardha, ...	1866—75	36·10	1876—85	46·63	+10·53
Brahmapuri, ...	1867—75	53·95	1876—85	57·48	+ 3·53
Chanda, ...	1866—75	47·14	1876—85	54·29	+ 7·15
Sironcha, ...	1867—75	44·17	1876—85	48·38	+ 4·21
				Mean, ...	+ 6·81

B—In unaffected areas.

Saugor, ...	1866—75	55·97	1876—85	40·62	—15·35
Damoh, ...	1867—75	54·76	1876—85	46 82	— 7·94
Jubbulpore, ...	1866—75	60·66	1876—85	56·28	— 4·38
Narsinghpur, ...	1866—75	55·46	1876—85	50·40	— 5·06
Hoshangabad, ...	1866—75	47·08	1876—85	57·73	+10·65
Khandwa, ..	1867—75	34·74	1876—85	33·32	— 1·42
Raipur, ...	1866—75	51·59	1876—85	54·47	+ 2·92
				Mean, ...	— 2 94

The contrast, thus shown, is sufficiently striking. But, taken as they stand, it can hardly be said that the figures do more than

afford a certain presumption in favour of the view, that the difference, shown by the two series of stations, is to be attributed to the preservation of the forests. In the first place, as I shall show elsewhere, the probable error of a ten years' average of a station in the Central Provinces is about 5 per cent., and this may be either in excess or defect. In the extreme case of the errors being in opposite directions in the two decennial periods compared, the greater part of the apparent increase of list A would vanish. And, in the second place, the majority of the stations in the second list lie to the north of the Satpura range; those of the first list either on the range itself or to the south of it; and as this range about coincides with the southern margin of the track, commonly followed by the cyclonic storms of the summer monsoon, the distribution of the rainfall might be much affected by the fact of a series of such storms following a more southerly or more northerly path; or by the western branch of the monsoon, which brings nearly the whole rainfall to the region south of the Nerbudda valley, being, in several years, relatively to its normal average, stronger and more rainy than the eastern branch, which contributes to the rainfall north of that river.

But there is another way of dealing with the facts, which will not be open to such objection. Any effect, really due to forest protection, must necessarily have been progressive. Some few years were passed in inducing the jungle tribes to take to settled cultivation; again, the reproduction of the forest growth on the tracts, formerly denuded, is a process requiring many years for its accomplishment; and, finally, the protection of the forests from destruction, by annual fires in the dry season, has been steadily extended year by year. If then it should appear, on comparing the rainfall of the affected tract in successive years, that the increase has been steadily progressive, and, on the whole, in a degree commensurate with the average difference of the two decennial periods above compared, the probability of such increase having been brought about by the protection of the forests will be enormously enhanced.

The data for this comparison are afforded by the following table, which exhibits in the second column the mean rainfall of the fourteen stations enumerated in the A list of the previous table in each year from 1867 to 1885. The third column gives what may be termed progressive averages. Each average is that of five years, obtained by the formula

$$c' = \frac{a + 4b + 6c + 4d + e}{16}$$

wherein *a*, *b*, *c*, *d*, *e* represent the mean rainfall in any five consecutive years, and *c'* the progressive average for the third year of the series. As a standard of comparison, I give, in the fourth column, the average rainfall of the whole Indian area, (with the omission of unrepresented tracts,) the data being deduced from the table on a subsequent page of this Memoir, and completed from the annual reports. The average rainfall is taken at 42 inches. Lastly, the fifth column shows the progressive averages of the rainfall of India computed from column 4.

Comparative Table of the mean annual rainfall of the forest region in the Central Provinces and of India generally from 1867 *to* 1885.

Year.	Condition.	*Central Provinces.*		*India.*	
		Annual mean.	Progressive average.	Annual mean.	Progressive average.
		Inches.	Inches.	Inches.	Inches.
1867, ...	Under *dáhya.*	55 08	...	44·8	40·2
1868, ...		33·59	...	35·4	40·3
1869, ...		47·97	45 28	42·4	41·0
1870, ...		50·42	47·71	43·5	42·6
1871, ...		45·52	48·45	42·9	43·0
1872, ...		53·31	47·47	44·3	41 7
1873, ...		39·18	47·02	37·5	42·2
1874, ...		50·48	48·85	46·6	42·4
1875, ...	Protected.	56·60	50·15	44·4	42·4
1876, ...		42·32	49·58	37·5	40·5
1877, ...		52·50	50·40	37·7	41·1
1878, ...		52·47	52·60	48·3	43·3
1879, ...		55·67	53·85	43·7	43·5
1880, ...		51·83	54·50	40·4	42·4
1881, ...		57·90	55·31	42·1	42 4
1882, ...		54·22	56·52	44·6	43·0
1883, ...		57·73	58·57	41·9	43·1
1884, ...		64·63	...	43·7	...
1885, ...		57·43	...	43·1	...

The variations exhibited in this table are represented graphically in *Fig.* 1, Plate XIX.*

Now the third column of this table shows, not only that the increased rainfall of the protected forest region has been, on the whole, progressive since 1876, (the year after protection was systematically enforced), but that its progression has been commensurate with the increase of the decennial average shown in the previous table; a very important point. As compared with the general average of the period antecedent to 1875, a rainfall of 48 inches, in integral figures, had risen to 58 inches in 1883; an increase of more than 20 per cent. Whether this increase will be sustained, at its full amount, by the results of future years is, however, very questionable. The rainfall of 1884 was extraordinarily high, and whereas, as may be observed in the graphic representation of these changes, the rainfall of the Central Provinces rises and falls, *pari passu* with that of the whole of India, in a somewhat remarkable degree, (having regard to the comparative smallness of its area,) the progressive average rainfall of India, as a whole, for 1883, was nearly 3 per cent. above the general average between 1867 and 1875. But, after making all due allowances, in so far as any legitimate conclusion can be drawn from the experience of the last 10 years, it would seem that, owing to some local cause, the mean rainfall of the afforested region of the Central Provinces here considered, an area of nearly 50,000 square miles, has been increased in a very remarkable degree; and I am unable to assign any other probable cause for this than that of the protection and consequent restoration of the formerly wasted forests.

The evidence, thus afforded, in favour of the influence of forests on rainfall appears to me to be of considerable weight and importance; in virtue both of the magnitude of the area yielding it, and the apparent distinctness of the result. With one exception, and one only, it fulfils all the conditions of a rigorous test case. The area is one and the same; the history of the changes to which it has been subject are definitely and accurately known; and, as will be shown elsewhere, the rainfall registers, if but few in proportion to the area, are sufficient to afford a datum, the probable error of which is small in comparison with the magnitude of the effect shown. The only remaining points, to which exception may conceivably be taken, are the trustworthiness of the records used, and the sufficiency of the periods compared to yield valid averages.

On the first of these points, I can add but little to what has been already written in the introduction of this Memoir. Speaking

* Not reproduced.—[ED.]

from recollection, (for I have been unable to obtain the desired verification of the fact from official records,) I believe that new rain-gauges of Glaisher's pattern, from one of the principal London makers, were furnished to all the stations, the registers of which are here dealt with, about the year 1867, at all events before 1870; that is to say, at or near the beginning of the period for which the registers are complete; and there are therefore no grounds for suspecting that the increase of the registered rainfall, during the last ten years, has been influenced by a change in the instrument used. And this is the most important consideration. With respect to the registering agency, as far as I have information, it has been the same throughout. Dr. S. C. Townshend, who was Sanitary Commissioner of the Central Provinces from 1866 or 1867, and who, in 1868, established the observatories, which, in 1875, were incorporated in the imperial system, took much personal interest in all the meteorological work of the province; and there is no doubt that his action was attended with beneficial results. But this change, like that of the instruments, dates from the beginning of the period now under consideration, at all events from 7 or 8 years anterior to 1875.

On the second point, *viz.*, the sufficiency of the periods compared, to yield valid averages, I have ascertained that a ten years' register of the Central Provinces stations, Jubbulpore and Nagpore, has a probable error of 5 per cent.; *viz.*, in the case of Jubbulpore 2·7 inches, in that of Nagpore 2·2 inches, and these may be taken as fairly illustrative examples of the whole province. These, however, are the probable errors of individual stations; and, as may be easily shown, and will be further demonstrated hereafter, the mean rainfall of a whole province is much less variable than that of a single station; for, if we take the average of either the first 10 years or the last 10 years of the figures in the third column of the table, on page 40, we have—

Average of 1867—1876, 47 45 inches; probable error, ±1·56
„ „ 1876—1885, 54·67 „ „ „ ±1·22

which is but little more than half the probable error of either Jubbulpore or Nagpore for an equal period. This is small in comparison with the difference of the two averages, *viz.*, 7·22 inches. Assuming the extreme case, that the first average is 1·56 inches below the real mean and the second 1·22 inches above it, these differences being both due to fortuitous and not steadily progressive causes, there would still remain 4·44 inches of increase unaccounted for. This is, perhaps, not such as to warrant conviction that the average rainfall of the Central Provinces south of the Nerbudda

has really increased by that amount; still less does it warrant the positive assertion that such increase, assumed as real, is due to the preservation of the forests; but at least, in so far as any inference is admissible from such data, the evidence seems to afford much support to that view.

Direct observations of a character, similar to those of Professor Ebermeyer in Bavaria, *viz.*, comparative measurements of the rainfall, at pairs of stations near the margin of forests, the one within, the other without the forest, have been carried on in Dehra Dún and Ajmere, during the last year or two, by officers of the Forest Department. Some of the results of these were given in the Administration Report of the Meteorological Department for 1885-86, and I have since visited the Dehra Dún stations and some of those in Ajmere. In the case of the former, the conditions are satisfactory; in so far, that the forest, on the site of the observatories, is a vigorous growth of, chiefly, *sâl* coppice,* with a well-defined boundary; and the observatory stations are, in the one case, well within the forest, in an opening only just large enough to prevent the gauge being sheltered, or its contents unduly added to by the drip of the trees; in the other in an open *maidan* of coarse grass and scrub, with only a rare tree here and there. But the interval, between the two stations of each pair, is hardly enough to show the full influence of the forest in the one case, or to exclude it in the other; and it can only be expected that, under such circumstances, any difference depending on that influence will be very small.

There are two such pairs within about 6 miles of Dehra Dún, on the skirts of the Sivalik forests, the one at the Ramgarh, the other at the Rajah's forest. In the case of the Ramgarh forest, at which the observatories have been longest in existence, the two observatories are 750 yards apart, the outer 400 yards from the forest boundary, the inner 350 yards from it. At each station, there are two rain-gauges, the one on the ground, the other at a height of 60 feet; being perched on the summit of a scaffold, which raises it above the top of the neighbouring trees. The rain-gauges are

* As testifying to the importance of this condition, I extract the following from a letter lately received from Sir D. Brandis, for many years Inspector General of Forests in India:—

"I would draw your attention to a point which I used to urge in India whenever I wrote on the subject, *viz.*, that forests, in order to exercise an effect [on the rainfall], must be dense, and must not consist of a few bushes and trees here and there. Fire protection alone has the effect of making the forest grow up dense, and I am disposed to think that the large extent of fire-protected forest in the Central Provinces may, in course of time, affect the rainfall."

of Symons' pattern, 5 inches in diameter, and the measurements are all made with the same measure-glass. The observer has been regularly trained in his duties, (which include keeping four registers of temperature and humidity, under corresponding conditions,) and his work seems to have been regularly performed. The results for the years 1884 and 1885 are given in the following Table :—

	1884.				1885.			
	Outer Lower.	Outer Higher.	Inner Lower.	Inner Higher.	Outer Lower	Outer Higher.	Inner Lower.	Inner Higher.
January, ...	..	..	..	..	4·20	4·56	4·48	4·63
February, ...	..	..	..	..	0·85	0·77	0·70	0·67
March, ...	..	..	..	..	0·48	0·42	0·39	0·36
April, ...	..	..	..	..	0·44	0·45	0·55	0·50
May, ...	..	..	..	..	5·35	5·06	5 99	5·79
June, ...	3·66	3·61	4·07	3·88	10·31	9·75	10·76	10 61
July, ...	25·64	24·72	26·46	26·44	9·81	9·27	9·90	9·88
August, ...	21·18	19·88	21·74	21·23	44·64	43·56	44·91	44·45
September, ...	17·53	17·19	18·78	18·01	6·24	6·06	5 51	5·47
October, ...	0·28	0·26	0·39	0·37	..	..	..	..
November, ...	..	..	..	..	..	..	..	..
December, ...	..	..	..	..	3·45	3·48	3·49	3 52
Total, ..	68·29	65·66	71·44	69·93	85·77	83·38	86·68	85·88

The observations at the Rajah's forest extend over a shorter period. The stations are less than a mile distant from the former, and the arrangements are similar ; the surrounding conditions of each of the pair being strongly contrasted. The outer observatory is 1,750 feet from the forest boundary, the inner 1,000 feet within the forest, which is of the same character as the Ramgarh forest—

	Outer Lower.	Outer Higher.	Inner Lower.	Inner Higher.
March 1885, ..	?	0·21	0 27	0 23
April „ ..	0·06	0·32	0·42	0 36
May „ ..	4·69	4 36	3·99	4·04
June „ ..	10·47	10·07	11·70	11·42
July „ ..	9·81	9 47	10·63	9·88
August „ ..	47 50	46·99	45·87	45 87
September „ ..	2 43	2·40	2 46	2·41
October „ ..	..	..	..	..
November „ ..	..	..	..	..
December „ ..	3 40	3·43	3·54	3·45
Total, ..	78·36?	77·25	78·88	77·66

In this case, while, in most months, the rainfall at the inner station is appreciably higher than at the outer station, as is shown both by the elevated and ground level gauges, this gross excess appears to have been nearly neutralized by falls in May and August, which were in excess at the outer station. The result of the evidence is therefore doubtful. But, in the case of the Ramgarh station, there does appear to be a decided balance of rainfall in favour of the inner station.

I do not give the results of the Ajmere observations, because, the difference of the conditions, within and without the boundary of the forest, as far as I have seen them depends, much more on the form and slope of the ground, than on the density of the forest growth; and I do not think the comparative observations have much bearing on the question at issue.

There remains one case which, although dependent on purely artificial conditions, might yet afford evidence of some weight in connection with the present subject, could we only be sure that the observations had been taken with the care and precaution, indispensable to any valid comparison.* In the very heart of the plain between the Ravi and the Jhelum, (two of the five rivers of the Punjab,) and about 50 miles to the south of Lahore, a vigorous forest has been established by planting, and irrigating the planted land from the Bari Doab Canal. The forest area covers 31⅔ square miles, and has now been established 20 years.† Outside the forest and to the east and south-east, are lands which are cultivated, also

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* For the following information I am indebted to Colonel Home, R.E., late Secretary to the Punjab Government in the Irrigation Department of the Public Works, and now Secretary to the Government of India:—"Two gauges are placed side by side; the receivers are 4½ feet above the ground. One is an ordinary tube gauge; measurements made with a graduated rod. The other a Watson's continuous self-registering gauge, which is taken to pieces, cleaned and readjusted on 1st April yearly. The bearings of the gauge are silver plated copper tubes, and, with very ordinary care in adjustment, they register very correctly. Instructions about registering rainfall are very distinct, and I believe they are obeyed."

† Mr. H. C. Hill, Conservator of Forests in the Punjab, writes:—"Cranga Manga is a compact block of 20,242 acres, of which 8,399 are wooded with planted sissu (*Dalbergia Sissoo*). The remainder is under ordinary scrub. The age of the plantation dates back to 1866-67; but little was done for 3 years, and the age of the forest may be taken as 16 years. The trees (excepting those in the canal avenue, averaging 63 feet,) of our best compartments average 50, 51, and 53 feet in height, and all compartments have an average of 40 or more.

"The watering of the forest begins in April and goes on more or less till September. Very little of it ever gets a second watering in the year; but that given is a good soaker of 3 or 4 feet depth of water. The ground to the east and south, except where two *rakhs* are touched, is all under cultivation and irrigated. Irrigation mostly from June to April."

with irrigation from the canal; and on the margin of this tract, 4 miles from the forest, is the small civil station, Chunian. Since 1864, a rainfall register has been kept regularly at Vahn, (within the forest, ½ mile distant from the nearest forest boundary,) and 6½ miles north of Chunian; and also at Chunian; and since 1870, a third register has been kept at Bhambeh, a station on the Bari Doab Canal, in a position very similar to Chunian, but 13 miles to the north-east of the forest boundary, and 19 miles north-east from Changa Manga or Vahn.

The rainfall chart of the Punjab shows that, in this part of the province, there is a steady increase of rainfall in a north-east direction, or from Chunian to Bhambeh; steady, that is to say, apart from the influence of purely local conditions; and, therefore, were the whole surface of the tract such as it is immediately around Chunian and Bhambeh, it might be anticipated that the mean rainfall of any intermediate station should be intermediate between those of Chunian and Bhambeh, in inverse proportion to their respective distances. The mean rainfall of Bhambeh, deduced from 17 years' registers, is 17·27 inches; that of Chunian, deduced from the same period, is 14·05 inches. If then Vahn, which is 19 miles from the former and 6½ miles from the latter station, had a rainfall intermediate between the above amounts, in inverse proportion to the distances of the two stations, the average of the same 17 years would be 14·85 inches. It is actually 15·76 inches, or nearly 1 inch above, the computed proportion.

I am far from considering this result as conclusive on the point at issue. In some years, the deviation from the mean proportions is very large; and on the average of the last three years, which, in this part of the Punjab, have been characterized with a remarkably low rainfall, the Vahn rainfall has been almost exactly in the inverse ratio of the relative distances of the two outer stations. Still, the evidence, so far, favours the idea, that the forest increases the rainfall.

The general conclusion to be drawn from the facts set forth in the foregoing pages is that, while no instance cited fulfils the requirements of scientific proof, the tendency of the evidence they afford is uniformly favourable to the idea that the presence of forest increases the rainfall.

The evidence is of three kinds. First, we have that of a large province, some five-sixths of which have always been a forest wilderness; but in which, for the first 10 years of the period of registration, the forest growth was greatly devastated, partly by *dáhya* cultivation, which completely destroyed the forest for the time

being, wherever it was carried on; and partly by annual forest fires, which destroyed the undergrowth and injured the larger trees. For the next 10 years, these destructive operations were suppressed, and the visible result is a forest growth, of such vigour and luxuriance, as to attract the attention of the Inspector General, when on his tour of inspection, to the question of its probable effect on the rainfall. During these last 10 years, the rainfall of the province has progressively increased, until it would appear to amount to 20 per cent. more than the average of the first 10 years.

The second instance is that of two pairs of comparative observatories, established on the Ebermeyer plan, in near proximity to each other, on the boundary of a protected forest; one of each pair being within, the other without the forest on open ground. Notwithstanding their proximity, in most months, the outer observatories show a slight excess over the inner. At each observatory there are two gauges, one at 60 feet above the ground, the other on the ground; and both afford consistent results. In the case of one pair of observatories, the total of 18 months' registers shows an excess in the inner high-level gauge of 4 per cent., in the lower of 2 per cent. In the case of the other pair, the registers of 12 months only show an inappreciable net difference of the totals, although in most months the forest gauges show a slightly enhanced fall.

Lastly, we have the case of a forest, artificially produced by irrigation, (during the two driest months of the year,) in a region, so dry, that cultivation is rendered possible only by irrigation. Seventeen years' registers, at a station within the forest, show an excess of 6 per cent. over the probable rainfall of that station, as computed from the registers of two stations, one of which is 4 miles, the other 13 miles, distant from the forest, and both on the borders of the cultivation.

The evidence is then, in kind, not rigorously conclusive; and it must be admitted that in no case has it been guarded by those special precautions which are demanded by strict scientific enquiry. But I have no reason to believe that it is not as trustworthy as observations made under the general supervision of intelligent and educated men usually are; and such as it is, it tends to support and confirm the conclusions drawn *à priori* from general physical considerations. It justifies, I think, at least, the view I have already expressed elsewhere, *viz.*, that I can no longer regard the long suspected influence of forests on rainfall as a question of equally balanced probabilities.

FAIRY-RINGS.—A mushroom spore may be supposed to start its growth in or beneath the dung of cattle, or a bird, on poor soil; the first crop of mushrooms, produced from the mycelium to which the spore gave rise, exhausts the soil of available carbon, nitrogen, phosphorus, potash and other substances, storing all it can get in its own substance.

The mycelium extends centrifugally "into fresh fields and pastures new," and the next crop of mushrooms arises at a distance from the centre; and so the growth proceeds. The grasses, among the roots of which this extension is going on, now avail themselves of the rich manure afforded by the decomposition of the older mycelium, and a struggle for existence is set up which results in the victory of the coarsest and rankest-growing species. These in their turn exhaust the available supply, and if cut it is removed in their substance: no wonder, then, that the inner parts of the area are poor, and support little or no herbage.

A fungus-spore starts its mycelium among the roots of the grasses, and the hyphæ obtain a hold on some root-hairs and fibrils; the mycelium thus parasitic on the roots reacts in a stimulating manner on the latter, and we have a symbiotic relationship established between the fungus and the host. The consequence is that both flourish, and become rampant. It may be that only some grasses are thus stimulated, or even attacked, and this will affect their struggle for existence, and result in the selection of a few coarse forms. In time the hyphæ or the roots get the upper hand, and this is expressed in the survival of the grass, or its decay; in some cases it is clear that hyphæ are living at the expense of dead and dying roots.—*Nature.*

GOVERNMENT OF BENGAL ◆ FORWARDED BY

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A FOREST TOUR AMONG THE DUNES OF GASCONY.

(Concluded from page 10).

Treatment of the Cluster Pine.

On our way from Bordeaux to Arcachon, we left the train at La Teste, and walked across the dunes to our hotel. The forest which consists of pine, unmixed with other species, is felled, in some blocks at 60 years, and in others at 72 years of age; but oaks *(Q. pedunculata* and *Q. Toza)* are now being planted among the pines.

After breakfast, we visited the Mouleau block, situated at a distance of three or four miles, in a southerly direction, from Arcachon. Here we found that, as elsewhere, the forest had been naturally regenerated with great success, there being a dense crop of young trees, 10 years old, and from 15 to 20 feet high, upon the ground. M. Boppe explained the system of treatment adopted for the cluster pine forests of this region. The tree has special requirements in the way of soil and climate; it will not grow upon limestone, and cannot stand cold, down to one or two degrees above zero (Fahrenheit), if prolonged for more than a week; neither can it be grown profitably for resin, at any great distance from the sea. It is most important, in the case of this, as of other species, that before the tree is introduced into any locality, a careful study should be made, in order to decide whether the conditions are such as will ensure success; and a forcible argument against the use of new species in extensive afforestation works is, that these conditions may not be fully known at the time. For instance, the cluster pine was largely planted in the Sologne and in Normandy

between the years 1830 and 1880; but during the unusually cold winter of 1879-80, nearly the whole of these forests, covering in the Sologne alone an area of over 300 square miles, were completely killed off.

The cluster pine seeds abundantly nearly every year, and its regeneration by natural means is easy to effect. As we had previously noticed in the Maures, we found that, wherever a seed-felling had been made, there was almost invariably a plentiful crop of seedlings on the ground; so that, if these could be protected against fires and grazing, the remainder of the trees might be removed, without fear of failure to obtain a fully stocked forest. The pine has long thin needles, giving very light shade, and the trees will not stand being grown close together; those only which are sufficiently far apart, vigorous, and have a well-developed crown yield resin in large quantities. Thinnings are commenced when the young trees are from 6 to 8 years old, and are repeated every 5 or 6 years. When the forest is 20 years of age, there should be from 250 to 280 stems per acre; but at 30 years, not more than from 100 to 120 of these should remain, the number being finally reduced to from 60 to 80, when, at the age of 70 or 80 years, regeneration fellings are commenced. With this number on the ground, the upper or cone-bearing branches are free, but not the lower ones; these latter should be allowed to touch, so that the natural pruning of the lowest of them may be effected. In order that the extraction of resin may be successfully carried on, it is necessary that the trees should have clean stems, free of dead branches, up to a height of some 16 feet; and to ensure this it is usual, as an additional precaution, to prune away the lower branches, at the time that the first thinnings are made, that is, when the forest is not more than from 6 to 8 years old; but this has to be done carefully, avoiding the removal of too many leaves at a time, as otherwise the growth of the young trees would be checked.

The light cover of the pine does not afford sufficient shade to keep down the undergrowth of grass, gorse, heather, broom, ferns, and other plants, which spring up in dense masses as the thinnings progress. These shrubs and herbs are much valued for litter and manure; and it is customary to export them, with the dead pine leaves, for these uses. This of course prevents the accumulation of vegetable mould; but it is said that the practice is useful to some extent, in that, when they have been removed, the resin collectors can move about the forest freely, and the risk from fires is diminished. It would, however, be much more advantageous if an

undergrowth of oak *(Q. pedunculata)* could be established instead of these shrubs. M. Boppe suggested that oaks should be planted when the pines are 10 or 12 years old, at which age they have usually suppressed the shrubs that grow up with them; but M. de Montcil would prefer to put them in at the time of the seed-felling, and keep them from being choked by clearing round them. However this point may be decided, the introduction of the oak beneath the pine could not fail to be of great value as a protection to the soil.

The enemies of the forests are our old acquaintances the graziers and the fires; the former, mounted on their tall stilts, driving their flocks wherever grass is to be found,—that is to say, where the young seedlings are growing. It is said that article 67 of the Forest Code (which provides that grazing rights can only be exercised in those blocks which are declared out of danger by the Forest Department) cannot be brought into force here, which seems a great pity. Fires cause very great damage; for, not only is the undergrowth of shrubs, and the mass of dead leaves and needles on the ground, extremely inflammable, but the pine trees themselves are so also. Conflagrations are sometimes caused intentionally by the shepherds, who desire to extend the area of their grazing grounds; but they are also frequently due to accidents, and it is said that they are sometimes caused by sparks from railway engines. When they occur, they are most destructive in their effects. In passing along the railway, at a distance of a few miles from Arcachon, we saw a large tract which was completely bare, the entire forest having been burnt off it. Unfortunately, there is no special legislation here, such as exists in the Maures and Esterel; and nothing can be done but to cut fire-lines from 30 to 70 feet wide, round, and at regular intervals through, the forest, so as to divide it into blocks of 250 acres each. These lines serve as roads, and as starting points for the counter-fires, which are lighted, when occasion requires it, in order to prevent the spreading of the flames. On each side of the fire-lines, as well as a along the main roads and railways, the undergrowth is carefully burnt off, so as to diminish the chance of accidents; and, every third year, the lines themselves are dug up, and all roots are extracted. This work, which is usually performed by women, whom we saw using a tool something like a large Indian hoe, costs about 5*s.* per acre of fire-line. The trees are sometimes attacked by a species of fungus; and it is customary to dig trenches round those which show signs of this malady, in order to prevent its spreading further.

While we were inspecting the old portion of the forest of La Teste, near Arcachon, to which allusion has previously been made, the Professor explained to us that resin is extracted from the trees, either in large quantities, so as to kill them in four or five years (*Gemmage à mort* = Tapping to death), or in comparatively small quantities, so as not to cause their death (*Gemmage à vie*). The first of these methods is adopted in all thinnings of trees aged 25 years and upwards, and also in the seed-felling as well as in the final felling. The operation is commenced five years before the trees are to be cut down, and is continued for four years, the trees being removed during the fifth year. The aim is to take all the resin that the tree can give, leaving it exhausted at the end of the fourth year; and to effect this, many cuts or wounds are made at the same time, their number depending on the size of the tree. Sometimes there are three or four; but, in the case of large trees, there may be as many as ten or a dozen, and sometimes even more. One result of this treatment is to cause an abundant growth of seed; and this fact has great importance when the last representatives of the crop are about to be removed, for it ensures the springing up of a full crop of seedlings. The effect is similar to that produced on fruit trees, by injuries inflicted on the branches, roots, or bark, with a view to obtain an increased crop of fruit. Trees which show signs of failing from any cause, commence to produce their successors.

The second method, under which the life of the tree is to be preserved, is practised only on those which have been selected to form part of the final crop (*arbres de place*). They are not tapped until they have a girth of from 44 to 48 inches, which is usually attained when they are from 30 to 40 years old; it is considered risky to take resin from them at a younger age. At first, only one cut is opened, and it continues to run for five years, when another, on the opposite side of the tree, is commenced. Then, half way between these two, a third and a fourth cut are opened in succession, and so on; if two cuts are opened at the same time, they should be at different levels, but the number should never exceed two.

The above is the improved system now in vogue. But in former years it was not the custom to tap trees to death, and the forest we visited was particularly interesting, as enabling us to see what the effects of the old practice were. Here we saw some trees of great age, showing as many as thirty-six wounds, and doubtless there were many more, the traces of which we could not detect. Such trees are probably at least from 150 to 200 years

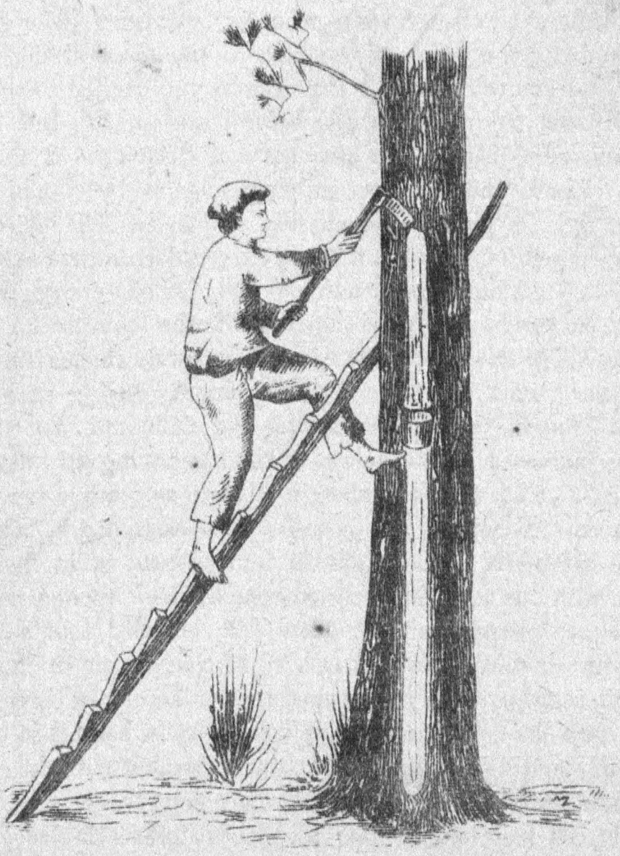
old. They present a most remarkable appearance; the lower 15 feet of the stem being swelled out into a sort of bottle-shape, and consisting, in some instances, of vertically detached fragments, through the interstices of which, light, entering on the opposite side of the tree, can be perceived. This bundle of sticks looks as if it would give way under the burden of the mighty crown which it contrives to support. M. Boppe had, however, something more important than this to call our attention to, *viz.*, the *effect on the forest* of this method of treatment, which, of course, since the tapping of every tree is continued until it dies, at a more or less advanced age, is almost exactly analagous to the selection method *(jardinage)*. Here then was an excellent opportunity to observe the effects of this manner of treating a species, which, like the cluster pine, has light cover. We certainly saw a number of trees of all ages and sizes, some of them from 90 to 100 feet high, and 12 to 13 feet in girth; but the ground was extremely badly stocked, much of it being completely bare. When a high forest is stocked with species of heavy cover, it is easy to keep trees of all ages growing together, for the shade of the taller ones does not interfere with the healthy growth of those standing below them. But in the case of trees of light cover, it is impossible to maintain, by this system, anything but an extremely thin crop, for the young trees cannot live under the shade of the older ones. For such species, the regular system, with the age-classes grouped together, is the only one that can be successfully employed.

On our way from Arcachon to Labouheyre, we passed through some private forests, in which we saw a large number of kilns in which pine wood was being burnt into charcoal; and we also inspected some ground which had, four years ago, been sown with a mixture of pine and broom, in lines 5 feet apart. The young crop appeared to be in a flourishing condition. Near the forest house, we saw some plantations of cork oak *(Q. occidentalis)* and also of *Quercus pedunculata*. Some tea seed had been sown as an experiment, but there does not appear to be much chance of its succeeding.

Tapping for Resin.

The cluster pine has large and abundant resin canals, the contents of which circulate much more freely in the sap-wood than in the heart-wood. In order to tap the tree, a cut, commenced near its base, is carried gradually upwards, to a height of about 12½ feet, but more rarely to 15 or 16 feet, and the resin, flowing

therefrom, is collected in pots and removed to the factory. This operation will now be described more in detail. Towards the latter end of February, the dry outer bark is removed, by means of a special tool *(barrasquite)*, from the place where the cut is to



be made, up to a point some 4 inches higher than it will extend during the coming season. The bark is taken off a surface wider by about 1 inch than the cut is to be, the object being, not only to prevent fragments of falling bark from becoming mixed with the resin, but also to save the sharp edge of the tool with which the cut is subsequently to be made and renewed. Early in March, the tree is again visited, and a wound of concave shape, about 4 inches wide, 2 or 3 inches high, and less than $\frac{4}{10}$-inch deep, is made in the sap wood, near the ground, with a peculiarly-shaped axe *(abchotte)*. Below this, a small curved zinc plate is driven into the bark ; this acts as a lip, to guide the flowing resin into the earthen pot placed below it. The wound runs freely

for from five to eight days, when the upper portion of it is renewed, by taking off a thin chip with the *abchotte*, and it is thus slightly heightened. This operation is repeated some forty times during the season, which extends to the 15th October, and, by this time, the cut has attained a height of 22 inches. The semi-solid resin (gallipot), of which the quantity is very small under this system, is scraped off, by the hand of the workman, from time to time; and, at the close of the season, the more hardened resin *(barras)* is removed with the *barrasquite*, and carried to the reservoir. At the beginning of the second season, the bark having been removed as before, the zinc plate is driven in at the top of the old wound, and the pot, supported below by a nail driven into the tree, is placed immediately under it. The collection is then continued; but when there are irregularities in the stem, or when it does not stand perpendicularly, chips of wood, driven into the bark, and ingeniously arranged, guide the resin in the desired direction. The cut is increased in height by 30 inches during the second year's work, and by a similar amount during each of the third and fourth years; but during the fifth and last year the height is increased by 40 inches. The cut having now attained a total height of 12 feet 8 inches, is abandoned, and a new one is commenced. When the tree is to be "tapped to death," the cut is made to attain its total height in four instead of in five years. The pot, which is sometimes closed with a little wooden cover, so as to reduce evaporation, is, when full, emptied into a wooden bucket, in which the resin is carried to a reservoir in the forest, whence it is subsequently conveyed to the factory in barrels, each holding 520 lbs. When the cut has risen in height, so that the workman, standing on the ground, cannot reach it with the *abchotte*, he provides himself with a sort of ladder, consisting of a notched pine pole, 15 feet long, which he places against the tree, and on which he mounts to the required height. When the pot is too high to be reached from the ground, it is removed by means of a sliding staff, which can be extended to a length of 11 feet, and is furnished with a pair of metal arms to grasp the pot; but sometimes a sharp, broad-bladed, hook-like tool, something like the *barrasquite*, is fixed to the sliding staff, in addition to the metal arms, and, with the aid of this instrument, the cuts are renewed by the workman, while standing on the ground, without his being obliged to carry and mount a ladder. The method above described, which bears the name of its originator, M. Hughes, was explained to us in detail, the whole operation being carried out in our presence. It has this great advantage, that the resin is not mixed

with any large amount of foreign substances, and that, as it runs down the length of a single year's cut only, the loss by evaporation is less than formerly, when it was collected in a hole at the foot of the tree. The collection, which is usually done by contract, can also be much better carried out and supervised under the new method. It is said that a man and his wife can look after from 2,500 to 3,000 trees a year.

It is very difficult to give figures accurately representing the annual yield of these forests in crude resin; but the amount is put down at from 200 to 400 lbs. per acre, the price obtained at the factory being from 14*s.* 6*d.* to 16*s.* 6*d.* per 100 lbs. It is also stated that a tree, tapped so as not to cause its death, yields, annually, from 6½ to 10 lbs. of resin, a very large one having been known to give about 16 lbs. Some figures relating to last season's sales, in the Gartey and Pilat blocks of the forest of La Teste, may prove of interest. The right to tap and fell, within five years, 7,528 trees, aged from 60 to 80 years, and constituting the final felling on an area of 118 acres, was sold for £1,592. This gives nearly £13 10*s.* per acre, and a little more than 4*s.* 2*d.* per tree. The yield was estimated to be 245,055 cubic feet of timber, 125,158 cubic feet (stacked) of firewood, and 2,082 cwts. of crude turpentine. It must not be forgotten that the above is the revenue for the last five years only; previously to this, thinnings have been disposed of, and the trees now sold have been tapped since they were about 30 years old.

Manufacture of Resin.

When travelling from Bordeaux to Arcachon, we left the railway at La Teste, to visit a resin factory close to the station.

The crude resin, brought to the factory in casks, is, notwithstanding the precautions taken, found to be mixed with a certain quantity of foreign substances, such as earth, chips, bark, leaves, insects, &c. After adding about 20 per cent. of solidified resin *(barras)*, scraped from the cuts, it is heated moderately in an open caldron, so as to bring it into a liquid state, when the heavier impurities sink to the bottom, and the lighter ones rise to the surface. The liquified resin, thus obtained, consists of two distinct substances, *viz.*, colophany, which is solid at the ordinary temperature of the air, and spirit of turpentine, which is liquid and volatile, and some of which is lost if the caldron is over-heated. These two substances are separated by distillation in the following manner:— The liquid resin is allowed to run through a strainer into a retort, a small quantity of water being introduced at the same time. The

rising steam carries the spirit of turpentine with it, and both are, after passing through a refrigerator, caught, in a liquid form, in a trough placed to receive them; the spirit, being lighter than the water, lies over it, and is easily drawn off. The colophany is then allowed to run out of the retort, and passing through a sieve, is caught in a vat below. Thence it is poured into flat metal dishes, and allowed to harden in the sun, under which process the finer qualities acquire a delicate amber colour. There are several classes of this substance, distinguished chiefly by their colour, which is a guide to their degree of purity, and these are known by various names, and have different commercial values. The impure residue left in the caldron is distilled separately, and yields rosin and pitch. The raw resin, collected from the trees in the autumn, is harder and less valuable than that obtained during the spring and summer.

We were told that, at this factory, 25 barrels (each containing 520 lbs.) of raw resin are distilled per diem in summer, and 16 in winter. The spirit of turpentine sells for 24*s.* per 100 lbs., and the colophany for 9*s.* per 100 lbs.; but the purer kinds, for the manufacture of which only the most liquid portions of the raw resin are put into the caldron, fetch from 13*s.* 6*d.* to 14*s.* 6*d.*, the price of the finest quality, known as Venice turpentine, rising to £4 10*s.* per 100 lbs. Comparatively small quantities only of the finer substances are manufactured.

Utilisation of the Wood and Substances extracted from it.

The effect of tapping the pine is to cause a flow of resin towards the lower portion of the stem, which thus becomes charged with that substance, and is rendered harder and more durable than the upper part of the tree. The resinous wood is used for various purposes: very largely for railway sleepers, when it is injected with creosote or sulphate of copper. We visited a factory at Labouheyre, in which the latter substance is used for injecting sleepers and telegraph posts; and the superintendent assured us that, for pine wood, it is much superior to creosote. We saw many thousands of injected pine sleepers at this and other railway stations, and were informed that they are largely employed on the lines. Planks and scantlings, of which a large stock was lying at Labouheyre, are sent for sale to Paris; while poles, extracted during thinnings, are used as telegraph posts and mine-props. Last year, when we were in the Cevennes, we found that mine-props from the Landes were employed there. Charcoal is also made in some forests.

On our way from Labouheyre to St. Eulalie, we visited an establishment for the manufacture of pinoleum, or pine-oil, which is used as a preservative for wood, and also, when prepared in a special manner, for burning in lamps, as a substitute for kerosine. The machinery was not working, and we were unable to study the details of the system; but the light given by the oil, which is used to a considerable extent in that part of the country, and possesses the great advantage of not being explosive, is very good.

CHAPTER II.

FORESTS ON THE ADOUR, NEAR DAX.

The morning after our arrival at Dax, M. Delassasseyne, the Inspector, and M. Tellier, *Garde-Général*, took us to see some cork-oaks, which are grown, at a short distance from the town, like apple trees in an English orchard. *Quercus occidentalis* is almost identical in appearance with the cork trees we saw in Provence; but its fruit ripens in two years, instead of one, as is the case with *Q. Suber*. The trees, which stand isolated from one another, and are much branched at about 7 feet from the ground, are visited once in every 8 to 14 years, when the cork is removed from the entire stem; an average sized tree then yields about 22 square feet of cork sheets, which represent a net revenue of about ten-pence a year. It is said that where *Q. occidentalis* occurs mixed with *Pinus Pinaster*, it has a tendency to drive the latter out of the field.

We spent the afternoon in inspecting the communal oak (*Q. pedunculata*) forests of Tilhieu, situated on the right bank of the Adour, a few miles above Dax; they are inundated, two or three times a year, to a depth of 12 or 14 feet, or even more. The part of the forest that we entered first consists of oak unmixed with other species. The trees are 40 years old, and about 50 feet high; they are to be felled at the age of 120 years. We remarked at once that they had an unhealthy appearance. They were much branched, and had crooked stems, covered with twigs (*branches gourmandes*) and lichen up to "high-water mark." Many of the larger branches were dead, while the stems were, in numerous instances, split by the action of frost; and it was evident that they required the protection of a lower stage of forest growth, which would remedy many of the existing defects. There were no seedlings on the ground, which was covered, in places, with ferns, brambles, a little gorse, and "butchers' broom" (*Ruscus aculeatus*). The forest is heavily grazed over by cows and bullocks,

which, however, do comparatively little harm, because the inundations, which leave a deposit of fresh soil behind them, prevent the ground from becoming hardened by the animals' feet. M. Boppe remarked that natural regeneration is here very easy to obtain, for the oak gives seed every year, a plentiful crop occurring every second year ; and the soil being extremely fertile, growth is rapid. But the old difficulty of treating a species of light cover as a pure forest has to be encountered ; if the trees stand too thickly together, they grow up tall and thin, and many branches die ; while, if heavy thinnings are made, after considerable intervals of time, there is a large development of twigs on the stems. The treatment of such a forest is a very delicate operation, requiring much skill ; and the only way to achieve success, is to make light thinnings frequently. If this be not done, the forest will, in all probability, be ruined. If it were possible to introduce a mixture of hornbeam, which, unfortunately, does not succeed here, this tree would serve to protect both the ground and the stems of the oaks, without interfering with their crowns ; and heavier thinnings, which would have a very favourable effect, could then be made. There are no harmful insects in this forest, probably owing to the periodical inundation of the ground.

Passing on, we traversed a younger portion of forest, where the oak is mixed with a few elms and maples *(Acer campestris)* ; and, leaving this, we entered a block in which the final fellings had been made from two to five years previously. Here the rapid growth of the young trees was very remarkable, those five years old having a height of 6 or 7 feet. The ground was densely covered, not only by young oaks, but also by a mass of tangled shrubs and brambles, which spring up immediately after the final felling has been made ; through these, the young oaks manage to force their way in two years, and, ultimately, they suppress them entirely. In this climate, oaks are not injured nor checked by spring frosts, which occur so frequently, and do so much damage, farther north.

We now entered the oldest part of the forest, aged from 120 to 150 years, which has been subjected to uncontrolled selection fellings, and has, at the same time, been grazed over, chiefly by pigs and geese, which eat enormous quantities of acorns, as well as by other animals. Consequently, instead of finding trees of all ages on the ground, we saw a somewhat thin crop of old trees of great girth, which are branched and heavy topped without being tall, and are covered, in many instances, with climbing ferns, of, apparently, one of the species commonly found on the lower

slopes of the north-western Himalaya. Under these large trees, are seen dense thickets of bushes, between which the animals graze; there are also a few young oaks, of stunted and unhealthy appearance, but not completely killed out by the cover, as they probably would have been, under similar circumstances, in a more northerly latitude. For here the light is more intense, and they are, on this account, enabled to maintain themselves under cover of the larger trees; but they cannot grow up, so that they do little or nothing towards the establishment of a regular gradation of age-classes. In fact the selection method cannot be successfully applied in the case of a pure forest composed of species of light cover, even when there is no grazing; but when, as in this instance, animals are freely admitted, the system fails completely. If this portion of the forest were now to be merely closed against grazing a large increase in the number of stunted young oaks would undoubtedly follow; and some of these would push their way upwards, in the more open places, but there would never be a properly constituted crop of sound and well-shaped trees of all ages on the ground.

But, fortunately, an effective remedy for this state of things can easily be applied. In order to get a complete crop of young seedlings, grazing must be entirely stopped, and the dense undergrowth of shrubs must be cleared. This latter process is found to act like a seed-felling, as it results in a marvellously dense growth of seedlings, which, a year or two after the bushes have been cut down, are sufficiently established to permit of the old crop being removed; and the forest is then completely regenerated.

We subsequently passed through parts of the forest where no grazing had been permitted for the last 8 or 10 years; but the bushes had not been cut away, neither had the old trees been removed. Here we saw a splendid crop of young seedlings in the more open places, and a quantity of suppressed growth among the bushes; all that was wanted was to complete the operation in the manner described. When this has been done, the seedlings and bush-coppice will grow up together; but, as has been previously mentioned, the oaks will soon push their way through the latter, and ultimately kill it out. There are here about 7,500 acres of this sort of forest, all of which will, in due course, be subjected to the kind of treatment above indicated.

We returned home through a block which is heavily grazed over, but contains some magnificent old trees of the most picturesque appearance, the effect being equal to the most beautiful parts of Fontainebleau.

CHAPTER III.

TORRENTS NEAR BARREGES IN THE PYRENEES.

From Dax, we travelled by rail to Pau, where we spent a few hours, and visited the splendid public gardens, which contain beech trees almost as tall as those at Villars-Cotterets. Thence we went by Tarbes and Lourdes, and on a branch line running up one of the valleys of the Pyrenees, to the terminus, which is on one of the roads passing through the mountains into Spain. Some picturesque but dirty Spanish peasants, homeward bound, were among those who left the station with us at Pierrefitte, whence we drove to Barrèges.

The drive was lovely; the snow-capped granite peaks overlook the stream, which has cut its way into the schist, and runs in its narrow bed between almost perpendicular sides, often of great depth. Barrèges, which is at an altitude of 4,200 feet, is a sanitarium for soldiers, its baths having the reputation of being peculiarly efficacious in the healing of wounds.

After breakfast, we started to inspect the torrent of Rioulet, on the left side of the valley. The hills are here, generally speaking, composed of firm strata, not liable to be washed down, and thus to cause disasters so serious as those which occur in the Southern Alps. But large avalanches are of frequent occurrence, and occasion much loss of life and property. At a short distance above Barrèges, our attention was called to a large mass of snow, which, during the month of April last, fell into the valley, and completely blocked it up. On the opposite side, works are in progress, with a view to clothe with forest the hill-sides above the cultivation and villages, and by this means to reduce the danger from avalanches.

We were now in a communal beech forest, which has a thin crop of old trees, with very good naturally-sown young growth on the ground; but there were many windfalls. We entered a nursery, where young beech trees are raised for filling up places in which the young crop is incomplete; and we then descended to inspect the large weir *(barrage)*, which forms part of a system of works constructed in order to reduce the slope of the torrent bed.

On one side of the main valley, the strata are exceptionally loose, and the water, cutting its way into them, causes the sides to fall in; thus, not only is an ever-increasing area of the hill-sides themselves ruined, but much damage is done in the lower part of the valley by the rush of water, and the deposit of silt carried down by it. This is an example, on a small scale, of what occurs, with such disastrous results, in the Southern Alps. The system

adopted for the treatment of this evil may be briefly described as consisting of a series of obstacles, erected in the bottom of the ravine, and behind which the rocks, gravel, and mud, brought down by the water, are retained. The slope of the bed being thus reduced, while, at the same time, it is raised, and consequently widened, by these deposits, the unstable sides receive support; and when they have been sufficiently consolidated, they are planted up. In this manner, the forces of nature are directed and employed by man, to restore the damage they caused when uncontrolled; much in the same way as they are in the treatment of the dunes, described a few pages back. The weir we inspected is constructed of masonry, and has a total height of 65 feet, including 20 feet of foundations. It is one of those made when works of this nature were undertaken for the first time in 1862; and it was in the nature of an experiment. It is now seen that its design is faulty in many ways, and it cannot be taken as a model of what such constructions should be.*

On ascending to a higher level, we looked across the main valley, and noticed a good many torrents, in process of formation, on the opposite side, a mile or so below Barrèges. The general appearance of the country led us to suppose that the bottom of the main valley was once filled by a glacial bed, through which the present stream has forced its way; and the secondary torrents, now cutting through the unstable sides, must be dealt with at once, before they go too far. It is the intention of the Government to buy the land with this object. We next entered a plantation of *Pin à crochet* (*Pinus montana*, Miller) and *Pin noir* (*Pinus Laricio*, Poir), planted in clumps. Many of these are dying off, and M. Luze, the Inspector who accompanied us, feels considerable anxiety regarding their future. It seems probable that the trees, having got into an unhealthy condition, have been attacked by a fungus, and, subsequently, by the insects which we found in many of those we examined. With regard to the system of planting in clumps, it is said that the plants impede one another's growth, and that it is much better to put them in singly. These plantations extend up to an altitude of 7,250 feet, larch being used above 6,500 feet. The plants are grown in temporary nurseries, which alone are suitable for mountainous regions, not only on account of the difficulty of carrying the plants over long distances, but also because the young seedlings should always be grown at the same level, and as

* On a future occasion the writer hopes to give a more complete account of the works undertaken in the Southern Alps, which are much more extensive and interesting than those near Barrèges.

nearly as possible under the same conditions in which they will find themselves when they have been put out. Before turning homewards, we had an excellent view of the snow-capped peaks, including the Pic du Midi de Bigorre (9,440 feet), which was close to us.

We returned home by the valley of the Pontif torrent, which is in a bad state, but has not yet been taken in hand. This gave us an excellent opportunity of studying the condition in which these torrents are found, before works to regulate them have been undertaken.

Returning next day to Toulouse, we noticed that the lower spurs of the Pyrenees, which are well wooded, are, generally speaking, covered with a simple coppice of beech, cut in vertical strips. This tends to the formation of torrent beds, which indeed appeared to be commencing in many places. Thence we travelled direct to Nancy, where we arrived on the 6th of May.

SOME FACTS REGARDING THE PRODUCTION OF RESINS AND TURPENTINES IN INDIA.

SINCE 1881 the question of creating a demand in England for Indian resins and turpentines has been before the Government of India, and in this connection some valuable preliminary information has been collected, which we will attempt to bring to a focus here.

Of all our conifers those which are likely to yield resin in sufficiently remunerative quantity are *Pinus Khasya*, *Merkusii* and *longifolia*, and perhaps also *P. excelsa*.

Pinus Khasya.

The resin of the Khasya pine is believed to be the most valuable in India, and has attracted the special attention of Sir Joseph Hooker. Forests of this tree are estimated to cover about 270 square miles, of which 230 are in Assam, the remainder being in Burma. Of the area comprised in Assam, only 33 square miles are at the disposal of Government, the rest being in private hands and regularly subject to jhooming, and, therefore, mostly too young at present to be in a condition to yield. The small area in Burma can, however, it is confidently believed, be largely extended and improved, nothing but fire-conservancy being required to transform the hill sides into pure pine forests. But the pine localities are in both provinces far removed from markets, and are

so little accessible, that the cost of 100 lbs. of crude turpentine delivered at Calcutta and Moulmein would, under present conditions, be Rs. 32 and 36 respectively.

In Assam the resin is collected in an impure state from cuts made in trees, and also in a clean condition by heating chips of thickly resin-impregnated wood in inverted earthen pots, and receiving the liquid resin that runs out into smaller pots placed below. For this latter process the wood of standing trees is made abnormally resinous by cutting a long blaze into the trunk about 1 foot wide and 4 feet long, the trees being cut down for use at the end of 12 months. A good deal of resin exudes from the blaze, and this constant outflow of resin in one direction excites an unusually copious secretion of it in the trunk, the wood cells of which thus become thickly encrusted with it. The resin that runs out is not allowed to go to waste, but is collected in a sort of hollow-bottomed niche cut into the trunk at the lower extremity of the blaze. Mr. Mann estimates that under the system just described a full grown tree will yield 68 lbs. of crude resin. The resin-encrusted wood of trees so treated contains 16 per cent. of its total weight of crude resin. Chips of this wood are regularly sold in the Shillong bazar for the purpose of lighting fires. It is obvious that only trees of a certain size can be so treated with any profit, their minimum age being estimated by Mr. Mann at 50 years.

In Burma the Khasya pine is never tapped for resin. The wood is used for torches by the villagers in the neighbourhood of the pine forests.

Professor Armstrong, F.R.S., Secretary of the Chemical Society, who has made an especial study of resins and oleo-resins, wrote as follows in 1881, regarding the crude turpentine of this pine :—

"It consists of a solid resin similar to colophony, and of a liquid 'turpentine oil.' The latter is remarkably pure and free from smell, and ought, I should say, to be very valuable for purposes for which the French and American oils are used. * * * Neither French nor American oil, especially the latter, are homogeneous, but this *Pinus Khasyana* oil, so far as I can judge from the examination of the small quantity at my command, is almost a pure substance."

A barrelfull of the crude resin was depatched to Professor Armstrong in 1881, after he wrote the above note ; but no further communication has yet been received from him.

Pinus Merkusii.

This pine is found only in Burma, where it covers about 50

square miles in the Thaungyin valley in the Tenasserim Circle. These forests are much more accessible than the Khasya pine tracts, and no difficulty is anticipated in extending them by the reservation of suitable tracts, as the population there is sparse, and the tree can be easily propagated. The cost of the Merkusii resin delivered at Moulmein is the same as that of the Khasya resin, but will be much reduced as soon as the valley is opened up to cart traffic. The few experiments hitherto made seem to show that a tree of 6 feet girth can yield 12 lbs. during the first year in which it is tapped.

Pinus longifolia.

The aggregate area under this pine is very large, and is comprised in the outer Himalayan belt, varying from 20 to 40 miles in width, from Nepál to the north-west frontier. No very approximate figure can be given for the total area lying inside British territory, but it certainly exceeds 2,000 square miles, distributed as follows :—

	Square miles.
Kumaun and Garhwal (Sarda to Ganges), ...	1,000
Jaonsar (Ganges to Tons), ...	300
The Punjab, ... not less than	1,000

of which only about 500 are at present workable.

Some information regarding the native method of tapping, yield, distillation, &c., is given in Vol. IX. of the "Indian Forester."

The system employed by the hill-men in Kumaun and Garhwal is to cut a sort of niche into the trunk about 3 feet from the ground. The bottom of the niche is hollowed out to receive the resin that trickles down its sides. The resin is collected as the niche fills, sometimes as often as every second or third day, but usually between the fourth or fifth day. The niche has to be deepened and lengthened from time to time, so as to freshen the wound and keep up the outflow of resin ; otherwise the old resin would harden on the sides and form an impenetrable crust through which no new resin could ooze out. The same niche is, as a rule, used for two years, and sometimes even for three, when no fires occur in the meanwhile to burn and scorch the resin-incrusted sides. The new sapwood is the main reservoir of resin, and in all tapping operations it is the sapwood that must be cut into. The season for tapping begins in February and ends in June, when the trees are again actively transpiring through their leaves and the secretion of resin diminishes. The process of collection could be continued

almost to the end of autumn, if rain could be prevented from getting into the niche, but the yield would be insignificant, and would not pay the trouble of collection. A high temperature and very dry weather combined are unfavourable for the outflow of resin. The yield per tree is very variable. Mr. Richard Thompson (Brandis, p. 507) puts it down at from 10 to 12 lbs. during the whole process of tapping. At Naini Tal Mr. Fernandez was informed that from 4 to 6 lbs. are obtained the first year, and about half that the second year. The largest outflow takes place when the niche has just been scooped out, as much as 1 lb. being obtained at the very first collection from an average tree. The hill men seldom concern themselves about the life of the trees they tap, and they generally work three niches simultaneously in one and the same tree. Taking the forests all round, a maund collected even by the process just described could be delivered on the railway for about Rs. 3-8.

Twenty trees, of girths varying from 7 to 9 feet, were tapped, as an experimental measure, according to the native system in Jaonsár. The yield from the middle of March to the beginning of the monsoon, towards the end of June, was on an average 3¼ lbs. of crude resin per tree. The actual cost of collection and carriage to Deoban, 3 miles above the end of the cart road at Chakrata, was Rs. 4 per maund; but as the quantity collected was only 65 lbs., the cost under a properly organised system of work would be about 50 per cent. less, and a maund could be laid down on the railway at Saháranpur for Rs. 3.

In the Punjab, trees were tapped as follows, in order to ascertain the yield, cost, &c. :—

Hazára Division.—430 trees, of girths varying from 4 to 13 feet, average 6 feet 4 inches. Tapping begun in May—June, and concluded July—August. Average yield of crude resin per tree = 3·8 lbs.

Chamba Division.—259 trees, of girths varying from 3½ to 6 feet, average about 4 feet. Tapping begun March—April, and continued, it is believed, till September. These trees were distributed amongst three separate places. The average yield per tree was respectively only 0·88, 1·95 and 0·62 lbs. respectively. The largest yield from a single tree was 2 lbs.

Bashahr Division.—150 trees on a northerly, and the same number on a westerly, aspect. Tapping carried on northerly aspect from 7th June to end of October, and on westerly aspect from 20th August to end of October. The average yield per tree on the two aspects was respectively 6 8 and 4·4 lbs.

The results just recorded are rather discordant, but this is hardly to be wondered at, when we consider the very dissimilar conditions under which the several experiments were made, and the difference in the mode of tapping. As the experiments were carried on in several places simultaneously in each Division, they were not so completely under the immediate supervision of the Divisional officers as they ought to have been. In the Hazára and Basháhr Divisions the French system of tapping was more or less followed; but whereas in Hazára the blazes were shallow and were freshened in only one place, and that too only four times in the three months, in Basháhr they were cut as much as 5 inches into the wood, and extended upwards every fourth day at first, and every seventh day afterwards. Hence the reason of the very much larger yield in the latter Division. The largest outflow in Basháhr was registered between 1st July and 15th September. But there is no doubt that the tapping ought to have been commenced several months earlier. The cost of collection varied from Rs. 2-4 to Rs. 18 per maund, and that of carriage to a railway from Re. 1 to Rs. 4-1 for the same quantity. But the results of small experiments on a few trees in different localities, in the absence of any organisation or previous experience, cannot be taken as a guide to what the cost will ultimately prove to be when systematic operations are set on foot. The present prices for the crude resin at Abbottabad and at Rawalpindi run from Rs. 7 to 8 per maund.

The following is a copy of a letter from the Anglo-Indian Varnish Company, to whom a small quantity of crude resin was sent for examination and report:—

"The crude turpentine arrived safely and had the appearance and consistency of lard. It was put, without any admixture of water, into a copper still with a worm (an ordinary *pot still*) and gently fired. The material that came out was turbid and something of the appearance of milk. The residue in the still was a white fatty substance with dirt. The proceeds of this first distillation were mixed with water and subjected to another distillation, or rather rectification.

"From this process we obtained—

(i). Oil of turpentine containing in solution a large quantity of resin.

(ii). Oil of turpentime more or less pure, which was limpid when received from the still, but has since become slightly coloured.

(iii). Oil of turpentine containing a very large quantity of naphtha.

(iv). Rosin, containing a large quantity of oil of turpentine and naphtha.

"The rosin thus obtained, on being subjected to dry distillation, gave off a considerable quantity of naphtha, and the residue (No. v) is a more pure rosin than No. (iv), but still contains much oil, which should not be present.*

"We made some copal varnish with No. (ii) when limpid, but found the varnish would not dry and had a peculiar smell.

"This, we must say, has not been a fair trial. We should have got the oil of turpentine much purer, and it is probably owing to this that the varnish does not dry.†

"It is the first time we have attempted to distil the raw material, and have no doubt but that further trials would lead to much better results."

With respect to the oil distilled by Mr. Fernandez at Naini Tal, Messrs. Morrison and Co., Pharmaceutical Chemists, to whom a sample had been sent for examination, reported that it was good, but a little wanting in strength. We have often used the oil of turpentine of *Pinus longifolia* in cases of rheumatism, &c., and have never failed to obtain as good results as with French oil.

In 1881 Professor Henry E. Armstrong, referred to higher up, examined a small quantity of *Pinus longifolia* turpentine. He noticed the "marked and not very pleasant odour" of the oil, but he had too little of it to be able to pronounce any opinion as to its value. On this account a barrelfull was sent to him for further examination and report, but we have not as yet been favoured with any communication from him on the subject.

Pinus excelsa.

No figures, even approximate, are available as to the aggregate area covered by this pine in India, but about 200 square miles‡ are supposed to exist between the Sarda and the Ganges, and very little between the Jamna and Ganges.

Experimental tappings have been made in the Chamba and Bashâhr Divisions. In the former Division 60 trees, of girths varying from 3 to 6 feet, were worked according to the native method from March—April to September, the average yield per tree being something less than ½ lb. The experiment in Bashâhr comprised 158 trees, and extended over 3 months; the average yield per tree was about 1·4 lbs. As in the case of the long-leaved pines in the same Division, the French method was followed, the

* This was the case also in Mr. Fernandez' experiments at Naini Tal, described in Vol. IX. of the "Indian Forester;" no amount of firing sufficed to drive out all the oil from the rosin.

† We have often used *Pinus longifolia* turpentine with paints, and have invariably noticed this defect of very slow drying.

‡ Doubtless an exaggerated figure.

blazes were cut deep into the wood, and were extended upwards from time to time.

The cost of collection, on account of the smaller yield, will always be relatively heavy as compared with the corresponding items in the case of *Pinus longifolia*.

General conclusions.

There can be no doubt that we possess very large resources, which only require proper development and exploitation. What is wanted is a sufficiently active demand to make the exploitation remunerative. But it would be a mistake to do nothing at all in the meantime, and wait until this demand arose before we began to explore our forests and ascertain the best methods of tapping and the conditions of soil, climate, locality and treatment that will give the largest and most profitable yield. All this preliminary work of enquiry and self-instruction must have been completed when we undertake to meet any demand that arises. For this purpose the workable areas in the various forest divisions should be explored and marked out on the map, and tapping experiments should be systematically carried out in some one place under competent and effective supervision. The best locality and agency for such experiments would be the School Circle of the N.-W. Provinces and Oudh in the case of *Pinus longifolia* and *excelsa*, and Assam and Burma, in communication with the staff of the Forest School, for *Pinus Khasya* and *Merkusii*. Through the kindness of Colonel Bailey, the Forest School has been supplied with a complete set of tools used in the French Landes, and a very good duplicate set has been made from these as models, and any number of such sets may be made by any ordinary smith. It is necessary that the collection of information should be centralised, for experience has proved that desultory efforts made here and there all over India never have any practical value. And it is obvious that the Forest School staff, composed of men whose whole time is devoted to the study and advancement of forestry in all its branches, and who are the most likely of all to preserve a continuity of ideas and principles of work, is the best agency to be entrusted with this centralised control.

In conclusion, we would draw attention to a mistaken belief held by many people that trees grown for timber cannot be tapped. The best cluster pine railway sleepers are those obtained from trees that have been tapped from an early age; as they are more heavily encrusted with resin, and, therefore, more durable. Even when boards, planks and battens are required, no injury is done to the tree if it is tapped to death just before being felled.

CUTCH EXPORTS FROM UPPER BURMA.

I SEND you herewith a cutting from the "Rangoon Gazette" on the subject of cutch exports from Upper Burma, which may possibly be useful as 'padding' for the "Indian Forester." It is to us a matter of very great interest, as we get a considerable revenue from cutch in the Tharrawaddy and Prome Divisions. Thanks to the diminished imports from Upper Burma, and to the high rates which cutch is now realising, I anticipate getting in the Tharrawaddy Division some Rs. 50,000 during the present year, as compared with Rs. 20,000 last year. I have already realised some Rs. 35,000 during the first 4½ months of the year. I have long been intending to write to you on the subject of cutch, and the history of the growth of the revenue which is derived from it, but have not been able to do so. Last year the highest price realised *per cauldron* for working cutch inside reserves was Rs. 68, whilst this year we have obtained in some cases over Rs. 250 per cauldron.

THARRAWADDY,
21st August, 1887. } T. H. A.

"It would be a very great pity indeed if any portion of the export trade in Upper Burma were to decrease under British rule; yet apparently the cutch trade is doing so. The decline began some years ago, and has gone on steadily year by year. In 1883-84 the quantity exported *vid* Allanmyo was very nearly 150,000 maunds; the following year it fell to 104,000 and in 1885-86 to 70,000. Of course this last named year was the year of the war, and a considerable decline was to be expected then; but during the next year, 1886-87, the country about Myingyan was fairly quiet—as quiet as it had been during the last two years of Theebaw's reign, and probably a good deal more so—yet in this year there was a further decline to 64,000 maunds. Thus in four years the export of this article has fallen to less than half. In the same period of time the exports *vid* Tounghoo have fallen from 10,000 maunds to *four* maunds only. This, however, we need not take into account here. At the best of times the Tounghoo trade was comparatively small; and, moreover, the extremely unsettled state of the Ningyan and Yemethen districts, where the cutch coming to Tounghoo is chiefly produced, would be sufficient to account for the total collapse of this trade.

"The continuous decline in the Irrawaddy trade, however, is much more difficult to account for. The comment made on it in the Inland Trade Report is to the effect that apart from the disturbed state of the country the outturn in the upper province is declining. Prices were good throughout the year of report, a great inducement to manufacturers,

which was not responded to. Burmese apathy and laziness may account for a good deal; but it is scarcely likely that the people of the cutch districts near Myingyan would have failed to respond to the stimulus of good prices, unless at the same time the article had become more difficult to procure in some way. The dacoits produced this effect in Ningyan and Yemethen, and the result was that the supply fell practically to zero. But in the Myingyan district the same deterring cause was not at work, at least not more so than it had been in the later years of Theebaw's reign, and yet the supply goes down to little more than one-third of what it had been some four years before.

"The real cause will probably be found to lie in the reckless and wasteful way in which the supply has been dealt with. It is notorious that under the Burmese kings there was no conservancy of forests of any kind whatever. They were merely leased to the highest bidders—in many cases probably to the highest bribers—and then the lessees were allowed to do what they liked with them. They might destroy young timber, and they had no inducement whatever to consider anything but how to make the most out of the forests during the current leases. Not only was a premium put on reckless disregard of the future on the part of lessees; but no precautions were taken against destructive fires. We know how much attention the Government of India has found itself compelled to give to prevent the destruction of forests from both these causes; and seeing that in spite of all its precautions waste does sometimes still occur, it is easy to understand that under Burmese control, or want of control rather, the destruction was very heavy every year.

"Cutch, of course, is a less valuable product than teak, but here it is under the control of the Forest Department, and precautions are taken to prevent reckless waste and to safeguard and provide for future supplies. Nothing of this kind has ever been attempted in Upper Burma; and though, of course, the country must be thoroughly pacified before the same measures as are adopted in Lower Burma for conserving forest produce of all kinds can be completely applied to the new province; yet it is evident from the steady decline in the exports of cutch by the Irrawaddy route that the sooner this article is taken in hand the better. In four years the quantity of cutch exported by that route has fallen to considerably less than half, and though there is some little compensation to the people in the increased value consequent on the smaller supplies, still the total value in 1886-87 was under five lakhs, against a value of nearly eleven lakhs in 1883-84. In other words, thanks to the want of proper conservancy, the people of the cutch districts above Allanmyo have received during the past year about six lakhs of rupees less than they would have done had the Burmese Government been possessed of prudence and foresight. This is a serious loss to a poor people; and we trust that it may be found possible, at an early date, to take the necessary steps to revive this declining industry."

COMPOUNDING FOREST OFFENCES.

Is "Ranchi" a Forest officer? He says so, yet I can scarcely believe it. His phrases are so exactly those with which I am familiar in the style of the 'garib-parwár' Revenue officer. What in the name of common sense is an "unfortunate offender." I can only say, with his views, an offender in "Ranchi's" Division must be a "fortunate" offender. I don't quite understand "Ranchi" when he says—"I never allow my subordinates to compound." If the power of compounding has been given to them, how can he interfere except to have it taken away again. But to return to my difficulty. With us, and I think rightly, only the Divisional officer has the power to compound. If the Divisional Forest officer enquires personally into each case, in what way is the offender better off in the matter of "backward and forward" journeys, than if he had been taken before a Magistrate? None, I take it quite the contrary. In fact, practically, in this way, the section is unworkable. The Divisional Forest officer must then compound on the reports of subordinates; in other words, though, theoretically, the power has been granted to him alone, and the responsibility is with him, still, in fact, he delegates the power and retains the responsibility. Surely common sense would say that the responsibility should go with the power, and then we have the necessary conclusion that the *power* should be granted to subordinates. Yet, here at any rate, opinion is almost unanimous that they are not fit to wield it. "A. J. C." quotes the present French practice, but surely, if he knows anything of French forest law, he cannot maintain that there is any comparison. Is "A. J. C." prepared honestly to say that his guards are fit to receive such powers as are given by the French *procés verbal* system, by which virtually a guard writes a man down as guilty, and leaves him to disprove it. "Ranchi" says, it is not necessary for "Ghati" or any one else to compound. Evidently "Ranchi" does not hail from this part of the world, or he would know that the higher powers (among whom by the way forestry is not directly represented) take "Ranchi's" view, that the unfortunate offender should be saved as much inconvenience as possible, and, time after time, regret that Divisional officers do not use the powers granted to them under section 67 sufficiently, and trust they will do so more freely in future.

"Ranchi" says that it is not a Forest officer's "special line" to work up a case for a Magistrate. I can only say I don't agree with him. I maintain that we have received in trust a most valuable property, and that it is a Forest officer's duty to take the

best possible means to protect that property. Further, I hold that the only way to protect efficiently is to make punishment as deterrent as possible, and this can never be under section 67, punishment under which is admittedly less rigorous than under section 25, &c. Arguments such as "Ranchi" puts forward in favour of the "unfortunate offender," it will be seen on reflection, are necessarily based on the assumption that the restrictions instituted since the latter's "younger" days, are not really necessary, have not been instituted for the good of the people through the forests, but for some other reason; "to justify the existence of the Forest Department," I was once told by an honest and consistent though extreme exponent of those views. The fact is that certain restrictions having been instituted, we, as Foresters, at any rate, must hold, not only that they are necessary, but, that they are to be enforced, and even in the interests of those on whom these restrictions press, the truest kindness is not to enforce them in a half hearted way, which will ensure their being set at nought, constantly, for a long time to come. But to take care that in every case the punishment is as heavy and consequently as deterrent as possible. I could write much more, but I have taken up already too much room though I have condensed as much as I could.

GHATI.

Note.—In the N.-W. Provinces and Oudh, Divisional Forest Officers do not compound offences without a personal examination of the offender, and they keep a book for the record of offences compounded, in which they write a short account of the charge, of the statement made by the defendant, and of the award.

It is possible that Bombay Divisions are too large for this procedure to be followed, but we can assure "Ghati" that the plan works admirably here, and that no Forest Officer would think of sending petty cases to a Magistrate, and especially if they were first offences, nor would they send any case to a Magistrate until they had first enquired into the case most carefully themselves, in the presence of the accused, and frequently until they had referred the case to the Government Prosecutor for his opinion, as to the character of the evidence producible in court.

Cases sent up to a Magistrate thus give the Divisional Officer and the accused far more trouble than cases compounded, and offenders are generally most anxious for section 67 to be applied, instead of their being put to the expense and delay and uncertainty of a criminal trial before a Magistrate, which are very serious affairs in these Provinces.

None but Conservators and Divisional Forest Officers are empowered to compound forest offences under section 67 of the Forest Act in the N.-W. Provinces and Oudh. —[ED.]

REPRODUCTION OF BAMBOOS.

YOUR correspondent "J. C. S. D. Mendes" has drawn attention to the above important subject, and it is one which all Conservators should take up and issue clear and definite instructions on;

for, as we all know, bamboos are one of the chief and most useful produce of many of our forests, and there is no produce which is more likely to deteriorate and eventually entirely die off from want of a proper system of treatment and cutting. Indeed, some of us may remember forests which in former years were so thickly stocked with bamboos, that it was not thought necessary to place any restrictions on cutting until it was too late, and the evil of excessive cutting of young bamboos had taken place, and the result now is that such forests are mostly denuded, and only scattered clumps here and there are met with.

Of course basket makers, &c., must be allowed to cut young green bamboos to a certain extent, but their requirements could be easily arranged for.

The removing of dry "stools or bamboos" could not be carried out in practice in extensive forests; also the suggestions 1 and 2 are hardly feasible; but, excepting for basket makers, the limit of age and season of cutting might be fixed and arranged for with profit.

20th December, 1887. A. J. C.

Note.—In the Central Circle, N.-W. Provinces, it is prescribed that four bamboo shoots should be left on every clump, and Mr. Fernandez has advised leaving eight shoots in every clump in the bamboo forests of Dehra Dún, for which he has just written a Working Plan. He has estimated that four new shoots are produced annually by each mature clump, and considers that to enable the clumps to thrive no culms less than three years old should be cut. In the Saháranpur Siwaliks the bamboo area is subdivided into nine blocks, only three of which are worked annually, and each block is then closed for two years. This system has been maintained continuously since 1881, and under it the yield of bamboos has been steady, and the bamboos have not become undersized. It is easier to control, in these rough hill-sides, than the other systems proposed, and under it, yearling culms, readily distinguished by having young foliage or none at all and by their colour, can be reserved if there is sufficiently good supervision to ensure this rule being observed.—[ED.].

I THINK your correspondent cannot save bamboos by cutting out shoots and transplanting them, and that they will die when the parent clump dies. Some kinds die out after flowering every five years, others ten or more. In 1868, I planted a large bari of játi bamboo in Oboepore, and ere doing so made enquiry of the old men of that and other villages to see if I was safe.

They told me they had never seen their játi bamboos seed, such an event could not have been missed or forgotten. It is now 1887 and these have not seeded, nor have the játies of the villages around. I offered Rs. 5 for five seers of guaranteed játi bamboo seed, and so far got nil, so this kind has a long life, 60 or 70 years at least.

S. E. PEAL.

JJ. Review.

FOREST ADMINISTRATION IN BRITISH INDIA, 1885-86.*

This review deals with the progress of Indian Forest Administration for the year ending March 31st, 1886. It is necessarily late, as the Local Government orders on the various provincial forest reports are only received gradually at Simla, but it would be an advantage if these Government orders could be issued before September of the year following that dealt with in the reports, so that the Inspector General's review could be published before the close of that financial year.

We welcome the present review as a terse statement of facts, and as indicating in the plainest language possible lines of improvement in each provincial administration in forest matters.

We find that the areas of the reserved, protected and unclassed Government forests in India are respectively 49,838, 14,963 and 17,612 square miles, giving a total of 82,413 square miles, or 9 per cent. of the area of British India, which is 868,277 square miles.

The area of forests under the control of the Forest Department has thus increased since the previous year in the Bengal Presidency, including Berar, by 89 square miles, in Madras by 1,903 square miles, and has decreased in Bombay by 13 square miles.

The rights of Government and of private persons in and over any forests are only finally settled when such forests become reserves under the Forest Act, and the following Table shows the proportion of such reserves at the end of the year under report, though it should be stated that full enquiry into the rights have not yet been made in all these areas :—

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* Review of Forest Administration in British India, 1885-86; by B. Ribbentrop, Officiating Inspector General of Forests to the Government of India. Simla: Printed at the Government Central Press, 1887.

Province.	Proportion of Reserved Forest Area.
	Per cent.
Bengal, ...	3
North-Western Provinces and Oudh, ...	3
Punjab, ...	1
Central Provinces, ...	23
Burma, ...	5
Assam, ...	5
Coorg, ...	15
Ajmere,...	5
Berar, ...	9
Madras,...	2
Bombay, ...	8

The review remarks that the proportion in most of the Provinces is insufficient for the ultimate supply of the country with forest produce, and that although it is supplemented by extensive areas of private forests, yet no reliance can be made on their permanency, and even the State forests cannot be expected to yield their largest possible outturn, unless they are worked under carefully compiled Working Plans, and the adverse rights in them are finally settled.

The question of the general taxpayer suffering from the unrestricted and increasing use of the State forest property by people whom accident has placed in their vicinity is referred to in several places in this review, and is one demanding the serious attention of the several Provincial Governments.

The area of leased forests from Native States is 625 square miles, being chiefly in Madras and the Punjab, with a smaller area in the N.-W. Provinces.

Taking the Provinces seriatim, we find that all possible increase of the area by including any available Government waste land is urged for Bengal, whilst in the N.-W. Provinces and Oudh, where

almost all forest lands have been reserved, the settlement of adverse rights in the Government forests is advocated, as the present arrangement by which villages near the reserves obtain large quantities of forest produce free, or at reduced rates, is characterised by uncertainty, which is neither to the advantage of the State, nor to the claimants of forest produce.

It has been proved that a judicious planting up of *usar* and ravine portions of the Province will increase the fodder and fuel supply, and the question of forming reserves in these unproductive tracts is still on the tapis.

The area of reserves in the Punjab is only 1 per cent. of the area of the Province, and the extension of this largely insufficient area by irrigated plantations is under the consideration of Government. In the Central Provinces, 23 per cent. of the area consists of reserved forests free of rights, and only improved management is required.

In Burma and Assam large extension of the reserved forest areas is urged, though this is more immediately necessary in the former province.

No more reserved forests can be acquired in Ajmere, but village forests should be taken up and managed under special regulations which have still to be adopted.

Forest matters are merely drifting in Baluchistan, where fuel is at famine prices, and where military necessities, as well as the increasing wants of the people, demand the permanency of a supply of forest produce. In Berar and Coorg a sufficient area of forest is reserved, whilst in the Andamans the forests have not yet been sufficiently examined for the selection of reserves to be possible. The constitution of reserves in Madras is still very backward, although it is proposed to constitute 7 per cent. of the area, or 9,950 square miles as reserves, but this is considered quite insufficient, and as there are computed to be 50,000 square miles of forest and waste lands in the Presidency, it should be possible to provide liberally for the wants of the people in forest produce and grazing.

In Bombay, there are large areas of protected forest from which additional reserves can be constituted, and the present area of reserves is large, but the distribution of the State forest property in the several districts is not quite satisfactory, especially in high lying lands to the east of the ghâts.

Under **Surveys and Working Plans** we read that the work of the Forest Survey Branch, chiefly in the Punjab and Berar, is

very satisfactory, and the work is very economically done, costing only Rs. 69 and Rs. 49 per square mile for 4 inch and 2 inch survey respectively. The Topographical Survey is working in Burma and local Forest officers in Assam, whilst in Madras the agency for forest survey is still unsettled, in Thána and Belgaum in Bombay the Topographical Survey has surveyed the forests, on the scale of 4 and 8 inches respectively, the latter being to our mind larger than is requisite for most of our forests.

Considerable progress has been made in compiling working plans; eight separate plans for the Punjab and Burma, having been submitted to the Inspector General of Forests, and after some alterations, have been sanctioned, 15 other plans in Bengal, N.-W. Provinces and Oudh, and other Provinces, were also in course of preparation during the year.

Altogether this important question, which was first placed on a proper footing under Dr. Schlich, when the first Assistant Inspector General was appointed with special reference to this work, is making rapid progress, and will result in greatly increased productiveness of our forests.

Regarding **Protection of Forests**, we find that 6,121 cases were taken into court, and 16,415 compounded by Forest officers, the former having increased, and the latter decreased during the year; the total number, 22,536 cases, being nearly identical with that of the former year 22,566, a remarkable instance of the truth of the law of averages. The percentage of convictions was 72, being kept down by the low figures in Coorg, Assam and the Punjab.

There is little to remark under this head except that in the Punjab, the fact that 40,000 cattle were impounded for forest trespass shows that the pound fees are no deterrent to trespass, though there seems to be no reason why people should not watch their cattle near forests, as they are obliged to near cultivations, and pound fees should probably be raised until they do so.

In Bombay, it is stated that the forests in the Thána district are systematically plundered under cover of the dead wood concession, which was given on the special understanding that if abused it would have to be withdrawn.

It is worth notice that of the 22,566 cases enquired into, 8,841 are in the Central Provinces, 6,297 in Bombay, 2,414 in Madras, 2,184 in the Punjab and 1,363 in Bengal, the numbers in the other Provinces being comparatively small, and showing that the relations between the Department and the people are excellent.

Under **Protection from fire**, we have the following summary :—

Province.	Area, in square miles.				Proportion of failures to area attempted.		Cost.				Year when fire-conservancy commenced.	Proportion of area under fire-protection to total area of reserves.	
	Attempted.		Protected.				Per square mile protected.		Per acre protected.				
	1885-86.	1884-85.	1885-86.	1884-85.	1885-86.	1884-85.	1885-86.	1884-85.	1885-86.	1884-85.	1884-85.	1885-86.	1884-85.
					Per cent.	Per cent.	Rs.	Rs.	Pies.	Pies.		Per cent.	Per cent.
Bengal, ..	1,296	1,259	1,038	980	20	22	15	16	4	5	1872	26	26
N.-W. Provinces and Oudh, ..	1,481	1,156	1,411	1,150	3	1	27	33	8	10	1869	*41	*34
Punjab, ..	251	324	243	324	3	..	4	3	1	1	1871	*18	*23
Central Provinces, ..	1,434	1,434	1,364	1,399	5	2	13	13	4	4	1864	7	7
Burma, ..	296	292	238	275	20	6	60	56	18	17	1857	7	†8
Assam, ..	234	210	227	199	3	5	39	52	12	16	1873	10	9
Coorg, ..	199	194	179	176	10	9	15	18	4	5	1876	83	81
Ajmere, ..	144	144	144	144	..	..	4	4	1	1	1874	100	100
Total, ..	5,335	5,013	4,874	4,647	9	7	20	22	6	7	..	15	14
Berar, ..	1,046	1,046	1,002	1,023	4	2	6	5	2	2	1870	68	68
Total Bengal Presidency, ..	6,381	6,059	5,876	5,670	8	6	18	19	5	6	..	17	16
Madras, ..	1,634	1,465	1,592	1,427	3	3	11	16	3	5	1867	*56	*45
Bombay, ..	11,429	8,547	10,766	7,983	6	7	‡	‡	..	..	1874	‡88	*92
Grand Total, ..	19,444	16,071	18,234	15,080	6	6	7	9	2	3	.	36	32

We give Mr. Ribbentrop's own account of the generally satisfactory nature of the measures taken for fire-protection, which is the basis of all forest conservancy in India.

"In the Bengal Presidency, there was an increase in the area attempted to be protected of 322 square miles, in Madras of 169 square miles, and in Bombay of 2,882 square miles; or a total increase of 3,373 square miles. In the Bengal Presidency, the principal increase took place in the North-Western Provinces and Oudh. The total area actually protected was in the proportion of 94 per cent. to that attempted, which is the same as that for the previous year, and may be considered a satisfactory result; and the more so that the cost of the operations has

* Leased forests included in area of "Reserves."
† *Taungya* areas not included in area of "Reserves."
‡ In Northern and Sind Circles, 98 per cent.; in Southern Circle (taking Reserved and Protected forests into account, as done by the Conservator), 79 per cent.

been sensibly less in almost all the provinces, notably so in the North-Western Provinces and Oudh, Assam, and Coorg. The largest failures occurred in Bengal and Burma, while the North-Western Provinces and Oudh, Berar, and Madras show the largest areas successfully protected. The cost of protection varies exceedingly; from two annas a square mile in Bombay to Rs. 60 in Burma. Special circumstances attaching to Forest Administration in Bombay, such as an exceptionally numerous establishment whose services are, in great part, available for purposes of fire-protection, and the necessity under which the people are of preserving the grass for their own use, render protection from fire in that Presidency an easier and a proportionately cheaper task than anywhere else in this country; while the opposite extreme of scarce and highly paid labour, added to the circumstance of the reserves being surrounded by unprotected forest, and by wildernesses of tall and dense grass subject to annual conflagration, make these works both costly and difficult in the case of Burma, Assam, Bengal, and parts of the North-Western Provinces and Oudh. The same causes operate to increase the areas under protection in Bombay, and to diminish them in provinces less exceptionally favoured, and in which protection has to march side by side with the means for making it effectual—means that are not always available. On the other hand, some of the provinces in the Bengal Presidency contain forests that are by their nature self-protecting, and, therefore, without need of special measures of fire-conservancy; others, again, are not sufficiently valuable to pay the cost of fire-protection, or, being merely grazing-lands, do not demand such protection. Thus in Bengal 67 per cent. of the reserves are said to be self-protecting, and in Assam 70 per cent."

Under **Utilization**, we read that the manner in which the demand for forest produce is being met is growing more systematic every year, and more in accordance with sylvicultural requirements, we again quote from the review—

"The treatment of the State forest property with regard to its utilization, and the manner in which the demand for forest produce is met, is growing more systematic every year, and more in accordance with the sylvicultural demands of the forests. The main difficulty which opposes itself to a more rapid progress in this respect lies in the long established custom under which the forests and forest produce were used in the most wasteful manner, and without regard for the necessities of future generations. It is naturally a difficult and slow process to remove such custom by reasoning. When an export market and the requirements of Government need only be considered, the forests are worked on pre-considered and economical principles, and are no longer at the mercy of contractors and speculators.

"In many instances, established rights interfere with the most economical use of the forests, which in such cases must be arranged so as to

admit of the exercise of such rights. The manner in which the requirements of the surrounding population are as yet met is, however, more frequently the cause rendering an economic forest management impossible—a management under which the property would yield the largest amount of produce available for the people in the vicinity and the largest revenue to the State.

"As regards the supply of timber and fuel, no difficulty is, as a rule, experienced, except near large centres of demand, and when concessions for dry wood and fuel have grown up uncontrolled with regard to the manner in which they are exercised. In most instances, however, even concessions of this kind can be brought into accord with the sylvicultural requirements of the forests, and they become purely financial questions in so far as the concessionists benefit at the cost of the general taxpayer.

"The exercise of grazing and the lopping of trees for fodder or manure, or the removal of fallen leaves and surface soil, are, however questions which deeply affect the management of the forest property from a sylvicultural, as well as from a financial, point of view. On the one hand, it must be recognized that it would be a waste of the resources of the State if the grass produced in the public forest property remained unutilized; but, on the other hand, the reproduction of the forests is rendered doubtful, patchy, and even impossible when grazing is permitted. It has been proved, moreover, that grazing is by far a more wasteful method of reaping the grass crop than cutting the grass; and reserves carefully protected for a few years only in the Poona Collectorate have, under the latter method, yielded a revenue many times as large as in the former more wasteful way. It is evident, therefore, that, whenever possible, grass cutting should be substituted for grazing. There are, however, localities and conditions when this is not feasible, and when it is, therefore, necessary to arrange for the exercise of grazing in a manner least hurtful to the regeneration of forest areas. This can be done only by the exclusion, as far as possible, of all browsers, by the periodical closure of areas under reproduction, and by the levying of fees representing more or less nearly the actual market value of the produce supplied. The question presents great difficulties on account of the irregular and inferior condition of many of the forests, and the system of "jardinage" which was, under previous circumstances of utilization, the only natural method of exploitation, and which can only be changed in course of time—for the very reason that the whole of the forests cannot be closed at once and be fire-protected. As long and till the actual market value is not levied on grazing supplied from State forests, herds will exist which are not wanted, and which are, therefore, uncared for.

"In spite of the difficulties which surround this question, considerable progress has been made in the regulation of grazing."

Under **Natural reproduction** we quote as follows :—

"Natural reproduction must always constitute the mainstay for the

maintenance and regeneration of the extensive forest areas of the Empire. Wherever fire-protection is successful, grazing controlled and restricted to areas not under regeneration, the exercise of rights and concessions properly regulated, and the treatment and exploitation of the forest based on scientific principles, there natural reproduction is, consistently with the prevailing natural conditions, reported to be progresing more or less favourably. The most important of these conditions is the quantity and distribution of the rainfall. Where rain is abundant, as in parts of Burma, Assam, Bengal, Bombay, and Coorg, seedlings come up so plentifully and grow up with such great vigour that, unless special care and precautions are taken, the weaker species either have no time to reproduce themselves or get crowded out and suppressed. On the other hand, in the arid parts of the continent, it is hopeless to expect the spontaneous restoration of forest areas that have been ruined by former wasteful use. In both these extreme cases, it is often necessary to have recourse to artificial means; in the former, in order to raise a more or less pure crop of the given valuable species, or to re-establish the forest growth where tall and invasive grasses have taken possession of the ground; in the latter, in order to get up a forest at all, a result that is often impossible of attainment without irrigation or some kind of watering. Again there are waste lands with inhospitable soil, which can be stocked only by means of sowing or planting. These cases excepted, in the larger portion of the remainder of our forest area mere protection and careful treatment will suffice to enable nature alone to re-establish and maintain a more or less full and valuable crop."

Under **Plantations** we find 1,476 acres added during the year, after subtracting areas excluded, whilst cultural operations extended over 60,095 acres, and 2,169 acres of taungyas in Burma, the latter being sowings on old temporary cultivations in the forests.

The total areas covered are now as follows :—

Regular plantations, ...	52,954
Cultural operations, ...	139,517
Taungyas, ...	41,731

though the latter includes 19 acres of topes in Madras, which should apparently have been shown under another head. The principal extensions referred to are in the Gorakhpur sissu plantations in Oudh, filling up blanks in the Changa Manga fuel plantation near Lahore, 2,169 replanted taungyas of teak and cutch in Burma, 31 acres of caoutchouc in the Chardúar forest in Assam, and broadcast sowings in Berar and Bombay, 61,000 acres having been re-sown in the Northern Circle of that Presidency by the 2,116 forest guards, who utilize their spare time in this work and in eradicating prickly

pear and climbers, a measure which might be followed elsewhere with advantage, as it is partially in the Central Provinces.

Under **Climber cutting and thinnings, &c.**, some progress has been made, but until the areas covered are given by all Conservators, the real extent of this work cannot be properly judged.

Under **Communications and Buildings** we find Rs. 2,77,870 spent as follows, in round numbers :—

	Rs.
N.-W. Provinces and Oudh, ...	80,000
Madras, ...	33,000
Assam, ...	28,000
Bengal, ...	23,000
Burma, ...	14,000
Berar, ...	13,000
Bombay, ...	8,000
Punjab, ...	8,000
Central Provinces, ...	4,000
Coorg, ...	2,000
Ajmere, ...	300

The Inspector General's remarks on this subject are instructive—

"The proportion of cost, and the necessity for works under this heading, will vary according to the accessibility of the forests and the distance of the markets. In these respects, the Himalayan regions, excepting always the Punjab, with its numerous large and navigable rivers, are, of course, the most unfavourably situated. On the other hand, it must not be lost sight of that, both as regards necessary roads and buildings for the convenience and well-being of their Forest officers, the North-Western Provinces and Oudh are far in advance of all the other provinces, and this is notably the case in Oudh, where the works have almost attained completion. Elsewhere, as in Bombay and the Central Provinces, the comparative unimportance of the annual expenditure on communications and buildings, although principally due to the greater accessibility of the forests and the smaller requirements in connection with these works, is unfortunately to some extent not warranted by circumstances, and a larger annual outlay would then appear to be called for."

And again—

"There can be no doubt that many of the best forests in the Central Provinces are underworked in the absence of proper channels of communication. It is true that the expenditure of the year was curtailed to the utmost by order of Government; still that of previous years has been out of proportion to the requirements of the case."

"In Bombay very much could be done towards opening out the more distant forests; and it is satisfactory to see that this subject has not

passed unnoticed by the Civil authorities. The mere fact of fuel having to be imported into Bombay from Sind would seem to show that the subject of communication does not receive all the attention which it deserves."

Whilst we read that in Assam—

"The work on the important Dambu cart-road was proceeded with: it opens out one of the richest forest tracts in the Garo Hills. The State forests now have to compete with difficulties in the way of demand, and it is most necessary to cheapen the means of transport."

Under **Working and yield** it is as yet impossible to give general figures for the whole of India for the reasons given below by the Inspector General, and we will not trouble our readers with the provincial figures, which are admittedly considerably below the real outturn of the forests.

We hope that in future years, this matter will gradually be brought under proper control.

"The total outturn in material obtained each year from our Indian forests is, both as regards its quantity and value, exceedingly difficult to determine—at least under existing conditions of administration and management. We have certain information, it is true, in regard to that portion of the yield which contributes to the revenues of the Department; but this constitutes only a fraction of the annual drain upon our forest resources, subserving as these do, almost everywhere, to an immense demand on the part of bordering populations, who are permitted to supply themselves with their requirements without any payment in return, or on payment of rates very much below those obtaining in the neighbouring markets. An endeavour which was made this year to secure some reliable data in connection with the forest produce received by the people free of charge, and the diminution in revenue incurred by the Department on this account, as on that of having to provide extensive demands at rates either very low, or altogether nominal in amount, has not proved successful. And yet, until in a position to supply this information, we can form but a very imperfect idea of the part played by the State forests in the national wealth, of their usefulness, of their necessity; since we have no sufficient evidence to show of that which is given away to the people, of the extent to which the people are dependent on the Government forests, on their permanency, and on their good management. Take the single district of Bahraich in Oudh as an instance. Some eighty thousand persons here obtain, free, all their timber, all their firewood, and all forest produce necessary to them, and graze their cattle at half the ordinary rates. Throughout India the agricultural populations living for considerable distances near the State forests enjoy some similar concessions from Government. In times of scarcity, reserved forests protected at great expense, and regenerated with a growth no longer

burnt, nor subject to the destroying agency of unrestricted felling, lopping, and grazing, have been frequently opened to the starving cattle, whereby much loss has been averted from the people, who, in return, have had to pay nothing, or something very trifling, for the succour thus timely afforded them. The beneficial influences of forest conservancy, as indicated in the use and value of the State forests to the people, can hence hardly be appreciated from a mere consideration of the growing revenues of the Department; since, side by side with this increase in the demand on the part of the paying portion of the community, exists the increasingiy heavy drain of the masses who contribute little or nothing in return. And yet, as we have observed, the former class of outturn has alone, up to the present, been recorded by Conservators with any approach to accuracy; and this is, in part, accounted for by the fact that where, as is often the case, the whole population bordering on the forests has permission to supply itself with every kind of forest produce that it may require for purely household purposes, the protective and executive forest establishments are then unequal to the task of exercising such strict control over exports by these people, at least without causing grave inconvenience to the consumers, as would result in a proper record being kept of the outturn from this source. Of course this circumstance applies most strongly to a daily necessary such as fire-wood, which constitutes the principal requirement of the masses, and is generally taken out by them in small quantities, most often in headloads, according as it is wanted for use. Still, even difficulties such as these should give way to an improved system of control and management, such as is indicated in a localization of the supply areas, and a provision that each class of produce shall be collected and removed at fixed periods only, and in fixed quantities, according to the requirements, not of each individual, but of each village unit. Generally speaking, therefore, there should be no insurmountable difficulty in the issue of such annual returns by Conservators as will furnish a correct idea of the total outturn from State forests in respect of produce unpaid for, or paid for at rates below those obtaining in the market."

Taking the figures for each Province seriatim, we find that the outturn of the Bengal forests has largely increased, being now 3,909 and 945 cubic feet per square mile of reserved and protected forests respectively. This increase is chiefly in the Sundarbans. The outturn has also increased in the N.-W. Provinces and Oudh, chiefly owing to Oudh sleeper operations, but the yield per square mile, which would be so useful for comparison, is not given. The old *Khám Tehsil* system of the Sub-Himalayan forests of Garhwál and Kumaon has been improved, no green timber being now removed except from previously marked trees, and the name of the system having been changed to *Revenue Depôt and Permit System.*

The outturn of the Government forests in the Central Provinces has fallen off during the last two years, owing, it is said, to the competition of more favorably situated private forests.

In Burma recent events have caused a large decrease in the outturn, whilst the value of the exports are Rs. 1,36,81,490, being Rs. 81·1 per ton as against Rs. 90·7 in the former year.

The outturn in Assam is insignificant, and the whole population as a rule gets all its wants supplied gratis; the leases of the right of collecting caoutchouc realised Rs. 31,438, but the exports were only 6,658 maunds, as compared with 7,290 maunds in 1884-85, thus tending to show the gradual exhaustion of the supply.

Rs. 27,954 was realised by the sale of 118½ tons of sandalwood in Coorg, which costs Rs. 25-6 per ton to collect, the average price obtained being Rs. 236 per ton.

The cardamom malés will be sold in future in Coorg in 21 year leases, and their management vested in the Forest Department, though the revenue will still be collected by the civil authorities. The exports of *padauk* from the Andamans amounted to 440 tons, and it is anticipated that shipments of this valuable timber to Europe will pay a fair profit, even if the price is not higher than that of greenheart.

Under *Financial Results* we have the following figures :—

No.	Provinces.	Revenue.	Surplus.	Deficit.	Proportion of Surplus to gross Revenue.
		Rs.	Rs.	Rs.	Per cent.
1	Bombay, ...	33,66,286	15,26,825	..	45
2	Burma, ...	20,23,859	8,72,907	..	43
3	North-Western Provinces and Oudh, ...	14,61,495	4,86,976	..	33
4	Madras, ...	11,98,650	2,60,678	..	22
5	Central Provinces, ..	10,36,894	5,91,462	..	57
6	Punjab, ...	8,50,419	1,74,986	..	21
7	Bengal, ...	5,97,432	2,27,033	..	38
8	Berar, ...	3,19,851	1,60,609	..	50
9	Assam, ...	1,96,656	..	14,838	..
10	Coorg, ...	89,386	23,696	..	27
11	Andamans, ...	23,944	..	13,091	..
12	Baluchistan, ...	14,962	..	837	..
13	Imperial, ...	14,708	..	73,537	..
14	Ajmere, ...	9,697	..	6,772	..
15	Forest Surveys (Berar), ..	631	..	42,309	..
16	Forest School, ...	273	..	23,986	..
17	Forest Surveys (Imperial),	202	..	18,978	..
	Total, ..	1,12,05,345	41,30,794	..	37

"The gross Revenue rose during the year from 102 lakhs to 112 lakhs, which constitutes the highest figure yet attained to since the Department was first organized.

"The surplus Revenue for the last five years is shown in the following Table, from which it will be seen that the surplus obtained during the present year was only slightly inferior to that of 1883-84, the largest hitherto made:—

Year.	British Territories.				Berar.	Grand Total.
	Bengal Presidency.	Madras.	Bombay.	Total.		
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1881-82, ...	23,04,184	2,03,489	6,58,936	31,66,609	80,526	32,47,135
1882-83, ...	26,42,642	2,61,090	8,11,583	37,15,315	1,36,960	38,52,275
1883-84, ...	29,05,697	1,66,971	9,38,928	40,11,596	1,36,396	41,47,992
1884-85, ...	17,86,464	2,70,411	9,96,119	30,52,994	1,10,666	31,63,660
1885-86, ...	22,24,991	2,60,678	15,26,825	40,12,494	1,18,300	41,30,794

Under the different provinces, we find that the surplus has increased in Bengal and has decreased by Rs. 65,000 in the N.-W. Provinces and Oudh, it has fallen off slightly in the Punjab, and has risen by Rs. 60,000 in the Central Provinces, in spite of the decreased sale of timber and fuel, whilst in Burma it has increased by Rs. 4,14,159, owing to the large sales from Government depôts in spite of the low price of teak, and the falling off in sales of produce to purchases. In Coorg there is a falling off of Rs. 12,586 in the surplus, owing to less timber and sandal wood being brought into depôt and reduced income from cardamoms. In Ajmere there is still a deficit of Rs. 6,772, whilst Rs. 60,000 worth of produce are given free to the people. Matters are improving in Baluchistan, where the deficit was only Rs. 837.

In the Andamans the deficit of Rs. 13,091 would have been a surplus of Rs. 19,700 had the timber supplied to local departments been properly entered by book transfer to the credit of the Forest Department, which was not done. In Berar, the surplus increased by Rs. 16,073, but there was a serious falling off of revenue from unclassed forests which was not explained.

The surplus fell by nearly Rs. 10,000 in Madras, and increased by the splendid sum of Rs. 5,30,706 in Bombay, but this is said to be due to temporary causes, so that the permanency of such a high income cannot as yet be hoped for.

The review closes with a statement of the exports of forest produce from India which we give—

Articles.	QUANTITY IN TONS OF 20 CWT. : IN THE CASE OF TEAK, 50 CUBIC FEET.		VALUATION AT PORT OF SHIPMENT IN 1885-86	
	Average of 5 years, 1880-81 to 1884-85.	In 1885-86.	Total.	Per ton.
			Rs.	Rs.
Caoutchouc, ...	483	328	6,56,204	2,001
Shell-lac, ...	4,502	5,606	43,96,417	784
Lac-dye, ...	164	89	31,630	355
Cardamoms, ...	96	134	5,60,012	4,179
Sandalwood, ebony, and other ornamental woods, ...	...	(Not known).	4,47,256	(Not known).
Cutch and gambier, ...	13,146	10,268	25,28,394	246
Myrabolams, ...	21,798	35,297	29,93,647	85
Teak, ...	55,043	50,076	55,05,155	110
Total in 1885-86,	...	...	1,71,18,715	...
„ 1884-85,	...	...	1,67,70,855	...
Increase in 1885-86,	...	...	3,47,860	...

III. Notes, Queries and Extracts.

M. Potanin's Journeys in East Tibet and East Gobi.—A condensed report of the results obtained by the three years' journey of MM. Potanin, Skassy, and Berezovsky, in China, Amdo plateau of Tibet at the sources of the Hoangho, and East Gobi, has just appeared in the Russian *Izvestia* of the Geographical Society (iii. 1887). Without repeating what has already been mentioned in his letters, M. Potanin gives in his paper a masterly sketch of the physical characteristics of the various regions explored by his expedition.

The route followed was from Peking, across the Utai-shan mountains which border the Peking depression in the west, and where the well-known Utai Buddhist monasteries are situated, to the city of Kuku-khoto. Thence south, across the Ordos region, to Lan-tcheu, capital of the Han-su province, and to San-tchuan on the middle Hoang-ho, where M. Potanin spent the winter of 1884-85, while M. Skassy wintered at the above city, and M. Berezovsky at Hoi-siang, on the Sy-tchuan frontier of the Han-su province. Thence the expedition proceeded south-east to Min-tcheu on the Tao-he, and to Sun-pan. Lun-an-fu was the utmost point reached towards the south, and the expedition returned to Lan-tcheu to spend the second winter at the Humbum monastery, close by Si-nin. The third summer was spent for the return journey, which was made *viâ* Kuku-nor, across the mountains which separate the Tsaidam from the Mongolian plateau, and the cities of Han-tcheu and Su-tcheu. Then, taking a course due north, the expedition crossed the Gobi, as also several ridges continuing the Ek-tag Altai in the east, and the Hanghai ridge, and reached the Orkhon River, whence it proceeded to Kiakhta and across Siberia to Russia.

The Peking plain, covered with fertile loess, is separated by a series of three ridges built up of gneisses and limestones, from the plateau of the Ordos, watered by the middle Hoang-ho. Of Europeans, only M. Przewalski, the missionary Huc, and M. Potanin's expedition have visited the Ordos—a plateau about 3,300 feet high, covered with shifting sands, the best part of which is on their eastern border. Owing to the moistness brought by the numerous streams which flow towards the Hoang-ho, the sands on the eastern border are not so bad as those described further west by M. Prze-

walski, and the *barkhans* are covered with bushes of *Shyaryk*, *Artemisiæ*, *Hedysarum lævi*, and thickets of the *Pugionium cornutum*—a new shrub discovered by Przewalski; sometimes dark growths of Thuja cover the *barkhans*. The hollows between the sandy hills are either covered with some bushes or occupied by the fields of the Mongols, who chiefly grow *setaria*, buckwheat, and hemp. The wet depressions, covered by meadow-grasses and partly with Halophytes, and called *tchaidams*, are enlivened by the herds and the mud huts of the half-nomadic Mongols. The sands are steadily moved by the winds from the south-west towards the north-east, and this constant motion explains why the Chinese gave to the sand-desert the name of Sha-he, or "River of Sand."

In the highlands which connect the Tibet mountains with those of Shan-si the expedition spent fifty days. Thick layers of loess cover there the horizontal layers of salt-bearing sandstones and conglomerates. The region is a high plateau deeply burrowed by the *cañons* of the rivers, which sometimes are 2,000 feet deep, and are cut both through the loess and the sandstones. The narrow *cañons* are mostly waterless, while the broader ravines are watered by rivers and therefore are the seat of many villages. There is little wind or rain, and the atmosphere is charged with dust.

In Tibet the expedition crossed only the Amdo plateau, separated from the Mongolian plateau by the Nan-shan ridge. For 400 miles the expedition crossed there a region, the lowest parts of which rise above 7,000 and 8,000 feet. Even the Hoang-ho at Gui-dui has an altitude of 7,600 feet, and the valley of the E-tsin at the Pabor-ta-sy monastery is 8,000 feet high; the valleys of the Urunvu and the Tumun-guan are at altitudes of from more than 9,000 to 10,000 feet. The highest parts of the plateau rise, however, to 12,000 feet, and Lake Kuku-nor is spreading its waters at the height of Alpine peaks, *i.e.*, 10,700 feet. Still higher grassy plateaus, where it never rains but often snows, and marshes spread over large areas, rise to the south of the lake. Only a few of the mountain-ridges which inclose this plateau are snow-clad. It has a quite original flora, discovered by General Przewalski. Forests are few; as to the high meadows, they are inhabited by nomad Tangutes, and, on lower levels, by a mixed population of Chinese and settled Mongols described under the name of Daldas.

The Alpine highlands watered by the northern tributaries of the Blue River, which separate the Amdo high plateau from the Chinese lowlands, are the most picturesque part of China. The routes which cannot follow the bottoms of the narrow and rocky valleys pass over the mountains, flights of steps being cut in the

rocks, or wooden balconies being built along the steep slopes of the rocky hills. Suspended bridges, swinging under the weight of a mule, cross streams which flow in a succession of rapids and waterfalls. The Chinese monsoons deposit all their moistness on the south-eastern slopes of the mountains; thick forests of conifers on higher levels and of deciduous trees lower down, clothe the mountain slopes. Maples, lime-trees, oaks, *Helwingiæ* and a number of shrubs and climbing plants are growing in impracticable thickets, while all crags are thickly covered with ferns, mosses, and orchids. Mollusks (*Bulymus* and *Helix*) cover the crags by thousands. And finally at the foot of the mountains the sub-tropical flora—palms, bamboos, banana-trees, and tea-trees—makes its appearance.

The villages and the towns—clean and well-watered—are strikingly picturesque, as the houses (with windows, like our European dwellings) are built in the shape of amphitheatres on the slopes of the steep forest-clothed hills. In some towns the roofs of the houses are the workshops and sitting-places of the inhabitants. The valley of the "Golden Lakes"—Kser-ntso—with its background of snowy peaks is especially picturesque.

As to the region crossed between the Amdo plateau and Kiakhta, it is sharply divided into two parts. The southern is a true desert, which stretches towards the north as far as the Khangai Mountains. The Nan-shan rises as an immense snow-clad wall on its southern border; then comes a narrow strip of inhabited and cultivated land, which is followed by a gravelly desert, where only a few trees of *Haloxylon Ammodendron*, and bushes of *Calligonum* and *Ephedra* grow here and there, while the course of the E-tsin is marked by narrow strips of meadows covered with *Elymus*. The depression of the E-tsin, which flows into the Gashiun-nor, has an altitude of only about 3,000 feet, and it is bordered in the north by the Tostu ridge, and three other parallel ridges, of which the northern is snow-clad. The valleys which separate these four ridges are waterless; old river-beds, now dry, are seen on their bottoms, but even the *Haloxylon* forests which formerly grew in their valleys are now disappearing, only decayed trees having been seen by the expedition.

As to the plateau in the north of the Khangai Mountains, it is covered with rich meadows, while the slopes of the hills are clothed with forests of larch; the Siberian cedar-tree also makes its appearance. In the lower valleys the Mongols carry on some agriculture.

The above account is followed by an ethnographical sketch of the Ordos-Mongols and the Daldas.

The results obtained by the expedition are very important. A survey has been made of a stretch of no less than 4,400 miles. Latitudes and longitudes have been determined at sixty-nine places. Two hundred photographs, 700 specimens of mammals and birds, a bulky herbarium, and rich collections of lizards, insects, mollusks, and rocks have been brought in. M. Berezovsky still remains in the region he has become so fond of, and he wrote last February, from Hoi-siang, that his journeys about Si-ning and Tai-tchan have enriched his collection with 500 more specimens of birds, some of which are very interesting.—P. A. K.—*Nature.*

THE TRUE CAUSE OF THE BREAKS IN THE NORTH-WESTERN RAILWAY.*—The annual floods, which have recently occurred, and since 1884 in the neighbourhood of Umballa and Jagádhri, have generally been ascribed to the denudation of the outer ranges of hills of forest trees and under-growth. This would be sufficient to account for sudden floods over a limited area, but is quite insufficient cause to explain the marked increase in the rainfall which has taken place. In 1884 a very heavy downpour occurred north of Umballa, causing destructive damage in Umballa Cantonment; on two or three separate occasions long breaches have been made in the North-Western Railway on both sides of Umballa; and in the present year heavier rain has been experienced in the neighbourhood of Kasauli than has been known for years.

The true cause is to be found in the large increase in irrigation which has taken place, south-west of the site of these floods (in the districts of Sirsa and Ferozepore, 130 to 150 miles,) since the opening of the Sirhind Canal.

To explain fully the action which probably brings about this increased rainfall in the month of August particularly, it will be necessary to make use of figures: first, to get an idea of the amount of water evaporated in one day; and, secondly, to obtain an approximate of the quantity of water which could be absorbed by dry air, such as would generally be found over a sandy desert, before condensation took place.

Take any area 50 miles by 20 miles in the neighbourhood of Sirsa, and suppose that of this 1,000 square miles $\frac{1}{400}$th part is daily under irrigation; then allowing $\frac{1}{3}$th of an inch for daily evaporation, we obtain the large quantity of one million cubic feet of water drawn up into the atmosphere daily.

A cubic yard of dry air at 80° Fah. will absorb the same number

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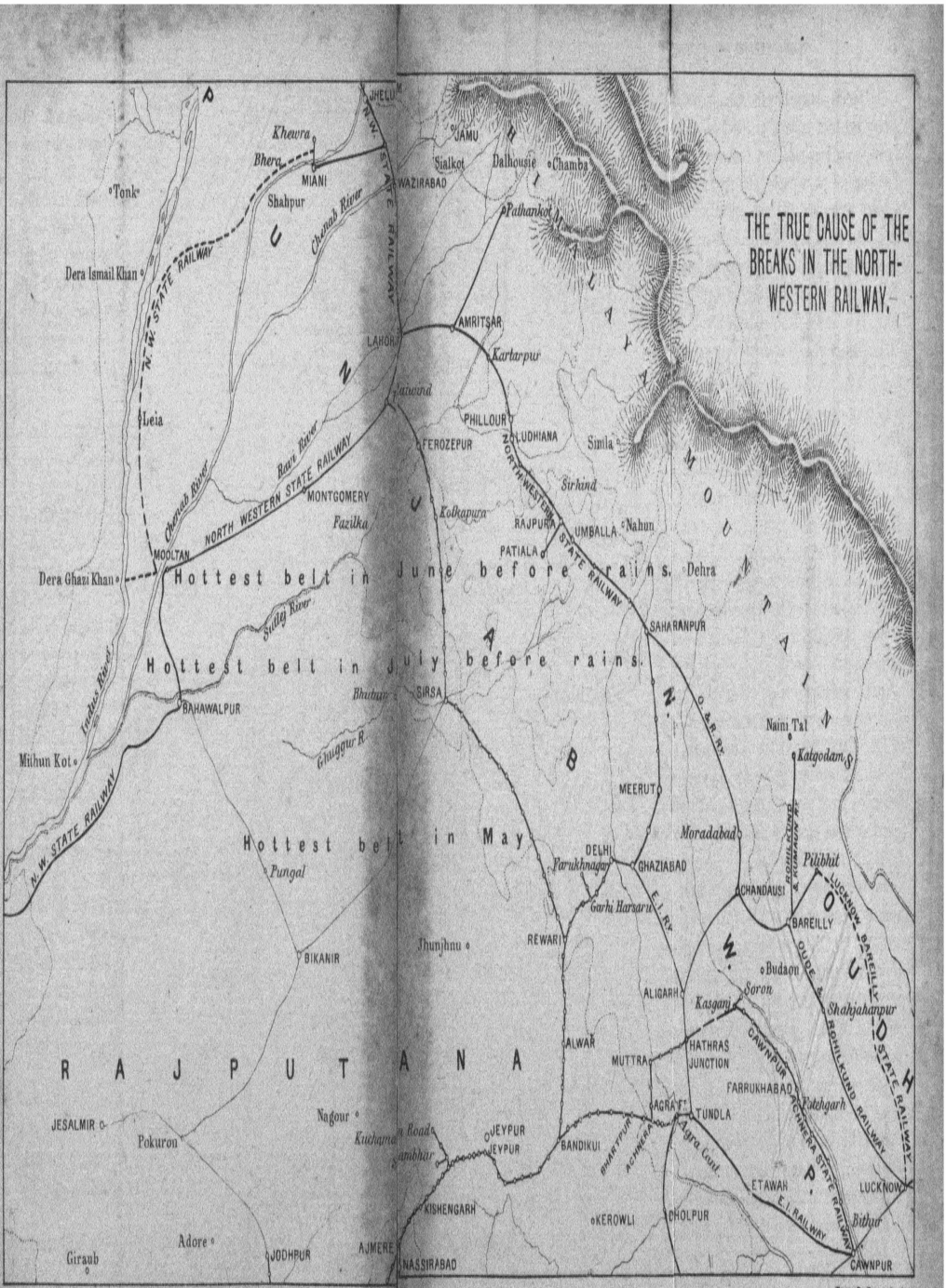
* By J. E. Hilton, M. Inst. C.E., Executive Engineer, P. W. Department, Punjab.



Lithe. T. C. Press, Roorkee.

Thos. D. Boys, Supdt.

of grains of water. Allowing that the air already contains 50 per cent. of full saturation, a cubic yard will further absorb 40 grains Troy; after allowing for decrease of absorption due to decrease in the temperature in the upper strata of air, a cubic mile will absorb not less than 350,000 cubic feet of water, and the atmosphere to one mile in height over 1,000 square miles is therefore capable of containing 350 millions of cubic feet of water. A sudden decreased temperature of 10 degrees would precipitate 70 millions of cubic feet. In April, May and June the hottest belt of country in India is to the south of the district of Sirsa, extending across the Rájputána desert from Delhi to Bahawalpur.

The hot air over this part rises and is replaced by a current of air on the south from the Indian Ocean, bringing with it the south-west monsoon; and on the north by a current of air from the north and north-east, carrying with it the more highly vapourized atmosphere which has generated over the Sirsa district. This vapour at this time of the year is dispersed, and only raises slightly the degree of moisture in the air over the desert.

Towards the end of June, and beginning of July, a change takes place, the belt of greatest heat passes over Sirsa and extends from Saháranpur to Jhang and Montgomery, constant changes of the wind occur, caused by greater heat on the one side or the other. The million cubic feet of water which is daily evaporated over the irrigated district is wafted hither and thither east or west, and for some days may accumulate; finally, the belt of greatest heat advances to the north of Sirsa, and the wind follows it.

Instead, however, of being drawn directly north, it deviates to the east, under the laws affecting currents of air passing from the south to the north, owing to the rotatory motion of the earth.

The wind becomes a south-west wind, carrying with it the accumulated moisture of several days; passing over Patiála and Umballa, it meets with a colder air coming from the hills, and by the sudden decrease of temperature the vapour of water is precipitated in floods of rain.

The same action probably takes place during a break in the rains. After a heavy fall of rain under the low hills, the belt of greatest heat is drawn back to the south of Sirsa, then gradually advances again to the north, and a repetition of the flood occurs.

It may be argued from this, that the larger the break in the rains in the neighbourhood of Umballa and Lahore, and the greater the heat, the greater and more severe the flood of rain will be when it at last bursts.—*Indian Engineering.*

The 10th November, 1887.

THE FORESTRY COMMITTEE.—This Committee, appointed to consider the best mode of promoting forestry and arboriculture, met on Wednesday last, under the presidency of Sir Edmund Lechmere.

The Rev. John M'Lellan, Principal of the Royal College of Agriculture, Cirencester, was examined with regard to the kind of practical instruction given there. They had 87 students at the college, and they were instructed in levelling, mechanics, chemistry, botany, and general farming. They had ample opportunities for teaching forestry in the Forest of Dean. A school for forestry might be started in connection with the Royal Agricultural College, but if a National School of Forestry were established, it would require £100,000. He believed that a much higher instruction in forestry would be a commercial gain to the country. In Scotland, where forests had been planted, the value of the land had increased as much again as arable land.

Lord Ducie, Chairman of the Royal Agricultural College, was next examined, and said he was of opinion that all estate agents should study forestry. The students at the Royal Agricultural College varied; they had men who had been colonels in the Army, commanders in the Navy, Indians, and foreigners. Men could live as economically as they liked when at the college.

Mr. Elliott, of Ledbury, Gloucestershire, thought the Forest of Dean would be an admirable place where experiments of forestry might be made. The development of forestry would undoubtedly be a national gain.

Lord Bathurst said his park adjoined the Royal Agricultural College at Cirencester, and he had woods extending over 2,500 acres. He should be glad to give facilities for lectures and illustrations on forestry to be given in his park. He thought there was only one alternative on this question; they must either go in for a very large scheme or try and supplement the present system of instruction by enlarging the Royal Agricultural College. He did not, however, think that forestry should receive more support from the State.

Sir James Campbell, Manager of the Forest of Dean, said the forest contained 16,000 acres covered with wood. They trained their own men in the west of England for forestry purposes. He thought there should be a representative body for forestry, but he did not think the scope for forestry in this country was sufficiently large to require a national school, the education given at the Royal Agricultural College in his opinion being quite sufficient. The witness gave the result of the advantage of transplanting

trees, which several of the Committee said was evidence of a most valuable kind.

Mr. Brittain, timber merchant, Wolverhampton, gave some information as to the importation of foreign timber, and

The Committee then adjourned.—*Timber Trades Journal.*

Light and the Formation of Flowers.—Prof. Sachs gives details of the experiments from which he has come to the conclusion that the ultra-violet and invisible rays of the solar spectrum are especially efficacious in the development of flowers. The experiments were all made upon the nasturtium (*Tropœolum majus*). If the rays of the sun are made to pass through a solution of sulphate of quinine, the ultra-violet rays are entirely absorbed or transformed into rays of less refrangibility, which are visible and of a light blue colour. If a plant is made to grow behind a screen of sulphate of quinine, the vegetative organs continue to be normally developed, but the flowers are entirely suppressed. Twenty-six plants thus grown produced between them only a single feeble flower, while twenty-six other plants grown under similar conditions, but behind a screen of pure water of the same thickness, produced fifty-six flowers.

The learned Professor believes that extremely small quantities of one or more substances formed in the leaves cause the formation of materials which are conveyed to the growing points to take the form of flowers. Acting like ferments, an extremely small quantity of these flower-forming principles may act upon large quantities of plastic substances. It may be assumed, then, that there are three distinct regions of the solar spectrum, differing from each other in their physiological action: the yellow rays and those near them cause the decomposition of carbon dioxide, and are active in assimilation; the visible violet and the blue rays are the agents in movements of irritation; and the ultra-violet rays are those which produce in the green leaves the substances by means of which the flowers are developed.—*Scientific American.*

Forests as Protection against Floods.—The "Englishman" asks:—"Are forests on the slopes of hills in India any protection against the flooding of rivers?" and then goes on to say:—"It has hitherto been commonly believed that they were, and the absence of timber in many places has been greatly deplored. But Mr. H. G. Turner, the Agent to the Governor-General in Viza-

gapatam, has come forward to deny the truth of this accepted theory, so far at least as many parts of the Madras Presidency are concerned. In the many jungles on the hills which Mr. Turner has visited, he has never seen a single spring of useful dimensions issuing in the hot weather from the hill-sides in Southern India. Rivers in that Presidency almost invariably have their origin on plateaux and in sloping valleys, and are formed by the gradual off-flow of the rainfall of the country. All we can say is that, while this may be true of Madras, it is equally true of the hills in some parts of Northern India that the water rushes down the hill-sides very much as if they were corrugated-iron roofs. Torrents and floods are thus formed, and to the hills we must look for the secret of the disasters by which communications are annually cut off, and the Government of India at Simla is left suspended in the predicament of Mahomed's coffin. Madras, it seems, is more fortunate."

ANALYSIS OF FOREST PRODUCTS.—The following extract from the report of R. Romanis, Esq., D. Sc., Chemical Examiner, Burma, is of interest to foresters :—

"The most interesting of these was the wood of *Artocarpus integrifolia*, which yields a fast yellow dye much used by the natives. It may be extracted by boiling the wood with water, but more conveniently with alcohol. As thus prepared it is a resin resembling the colouring-matter of turmeric—

Composition—

Carbon, ...	61·67
Hydrogen, ...	6·67
Oxygen, ...	31·66
Total, ...	100·00

"The leaf of the teak tree when crushed yields a red dye which dissolves in alkalies, forming a blue or violet solution. It is a mixture of two or more substances. The colour is principally due to a crimson body which may be separated from the others by ether, which dissolves it. It forms insoluble compounds with lead and baryta.

"The *nim* tree, used as a febrifuge in India, yields a resin which appears to be the active principle. The examination of it is not finished.

"*Organic Analyses.*—These were various products from teak examined at the instance of the Forest Department. There is a dye resembling litmus extracted from the leaves, while two or three may be prepared from the resin which contains a quinone hitherto unknown from which they are derived. This substance also is found in teak-tar. The quantity varies with the age of the tree, being greatest in old trees."

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THE ROAD TO PANGI (CHAMBA).

FROM Chamba to Kilar in Pangi there are seven marches as follows :—

	Elevation.			
Masrund,	4,000	feet,	12½	miles, road very steep and bad in parts.
Kalel,	4,000	„	9½	„ mostly easy, but parts steep.
Tisa,	6,000	„	12	„ „ „
Alwas,	7,000	„	12	„ „ „
Salrundi,	11,000	„	11	„ steep in parts } cross Sach Pass
Donai,	10,000	„	7	„ „ „ } 14,328 feet.
Kilar,	8,400	„	10	„ steep but good road.

An alternative for the two first is Tundu (5,000 feet), 12 miles ; Chunan (forest house 6,500 feet), 12 miles ; Kalel, 6 miles.

The regular road from Chamba to Pangi is, as stated above, *vid* Masrund to Kalel, but this has many drawbacks ; in the first place the road is badly laid out, violating all scientific principles, parts of it being so steep that to call it a "bridle road" is a mere mockery. The easiest way to ascend these parts is to get off one's pony and drive him ahead or lead him. Again, after going up a miserable road, too steep to ride, one finds one has immediately to descend just as bad a piece. This sort of thing is, to a well regulated mind, simply maddening, and on arriving at camp one finds, as stated by Andrew Wilson in his "Abode of Snow," that "feelings of exasperation are in the ascendant." The Chamba State is not remarkable for good roads anywhere (except in the Barmaur valley), but there are places on this "Main road to Pangi" that could not be surpassed for viloness in any country, and yet there have been European officers as Superintendents for many years. Those who have not constructed roads are apt to imagine that they cost too much to be thought of, yet

an excellent road could be made through this line of country for about Rs. 200 to Rs. 300 per mile. Another drawback in the Masrund route is, that it is on the south side of the range, and is thus exposed to the full rays of the sun. A much pleasanter road is that up the Sao valley *viâ* Tundu as far as Kalel, at which place the main road is again joined, onwards it is not so bad. The first march up the Sao valley is about 12 miles to a place called Tundu, rideable for about 7 miles, at a walk, then merely a footpath ; this route has one great advantage, that of being on the northern side of a range, so that starting at about 4 p.m. in summer, one can travel in shade nearly the whole of the first march, and next day by starting early, be up at a high elevation before the sun appears.

The Raja is making a grand road up this valley to his Sao "Kothi," which will join the old Hul-Chánju road, and this will, when completed, probably become the "main road" as far as Kalel. Beyond Tundu the Forest Department are making a good bridle path, which will in time nearly join on to the new Sao road, leaving a connecting link to be improved. From Tundu onwards the road gradually ascends at an easy gradient to the top of the Rundhar range, and then as easily descends through the Chatri-Sikri forests to Kalel, a distance of 16 to 18 miles. At present this new road has only reached to about a mile above Tundu, but will be extended next year. It is a good road about 6 feet wide, and, including walling where necessary, stone causeways at nallas and a little blasting, has as yet cost only Rs. 150 per mile for 8 miles. It passes over the range at about 9,000 feet elevation, and continues on through the Chatri-Sikri forests to the village of Chunan ; it is the main road here, of a system that will in time traverse the whole forest, being joined at various points by footpaths 2 feet to 3 feet wide, costing Rs. 30 to Rs. 60 per mile. The descent from the Pass is through glorious forest scenery to the village, on the boundary of the forest. Just above the village on an open spur, but sheltered by a grove of grand oak trees, stands the forest house. This was built in 1886, and is a neat little house constructed entirely of deodar timber, containing one central room and two smaller ones, verandahs, &c.

It is a comfortable clean little place, and cost Rs. 540 exclusive of the value of the timber. This style of house is preferable to the old one of kucha walled houses that used to be built, and experience has shown that these wooden houses last fifteen years or more with very little repairing being required.

The house was a necessity, because there will be much work in this valley. The three forests of Chatri, Sikri and Rupani, which

adjoin here, contain in all over 2,500 acres, a very large block for the Chamba State. Besides the destructive part of forestry, *viz.*, felling, a great deal of regeneration work of all kinds is being done here. There are seven nurseries well stocked with deodar plants for future planting. A great deal has also been done in the way of cutting out and girdling inferior species in the vicinity of deodars; portions have been closed to grazing with excellent results, and many places have been terraced under seed-bearing deodars, these have been most successful; in many instances the terraces have the appearance of well stocked nursery beds. Where the inferior species have been cut, are to be seen hundreds of deodar seedlings, and though many die the first year, still sufficient survive to re-stock the area. Among the inferior species the "killar" (*Parrotia Jacquemontiana*) gives the greatest trouble, as each tree, as it were, is composed of perhaps twenty or more stems, all of which have to be cut, besides which, it coppices very freely. Planting of deodars has also commenced in Chatri forest, and will go on regularly now.

These forests have been recently worked for sleepers, but still contain some 3,000 first class deodars, which will be felled ten years hence. The distance from the sleeper works to the river Siul (a tributary of the Ravi) varies from 5 to 8 miles. The sleepers are partly dragged and partly carried by Kashmiris, who come from the Púnch country, and are a fine athletic race; they come over yearly to the work, to the number of 200 or more. In the steep parts of the forest they drag the sleepers over a path made for the purpose; slabs are laid on the path, and the sleepers dragged on these by means of an iron peg driven into the end of the sleeper, a second sleeper is joined on, and in this way two are taken down at the same time. When the more level part of the road is reached the friction becomes too great, and the sleepers are carried on the men's shoulders, this will show what a strong set these Púnchis are, for these "green" sleepers containing about 4 cubic feet each, must weigh about 160 pounds. The whole lead is divided into daks of some 2 miles each, and one man takes perhaps six sleepers a day. Just above the river there is a very steep bank, some hundreds of feet high, this was a great obstacle. It was overcome by means of a sleeper shoot 2,300 feet in length, which zigzags down the face of the cliff. This shoot is formed of rejected sleepers placed on edge on either side, the bed being made of slabs nailed on cross pieces, and is sufficiently steep to take the sleepers down of their own accord; it works excellently. At each turn in the zigzag, and there are seven in the whole distance, there is a

soft bed of earth and branches into which the sleeper falls; a man is also stationed at each turn, who quickly shunts the sleeper round into the next turn and off it goes. The last portion of the shoot for about 50 feet is nearly level so as to lessen the speed, but is kept watered to preserve an even run, and the river bed at the place where the sleepers finally drop into the water, has been deepened and freed from large stones to prevent damage. The sleepers take four minutes to go the whole distance, ending up with a graceful "header" into the river at the bottom of the shoot. Formerly they used to be simply thrown over the cliff, and of course 20 to 40 per cent. were broken in the process; now, perhaps, one in a hundred is damaged by being jerked out of the shoot. The highest rate paid is Re. 1-1 per sleeper for the greatest distance, and includes felling, logging, sawing, carriage (with cost of making paths in the forest) and launching; the cost of conveyance to the sale depôt at Lahore is 2½ annas, and as they sell for from Rs. 2-12 to Rs. 3-4 each, a handsome profit is made at present. The Púnchis who do all the carriage are the only people who will undertake it, the Chambese are too lazy, weak and well off to attempt it except here and there. Each Púnchi makes between Rs. 50 and Rs. 100 clear profit during the season to take back to his home. I asked if they were not becoming very rich, but was told that there was "barra zulm" in their own country; they have to pay Rs. 3 yearly for each buffalo grazed, and one anna for each sheep or goat, against 13 annas and one pie respectively in Chamba territory. They say they prefer to work for us, though it is eleven marches to come, because in Badrawar (Kashmir) they are paid partly in grain, of which they do not approve. The sawing of the sleepers is, however, done partly by Chamba villagers and partly by men imported from Amritsar. The latter do the best work, but are more expensive, and if the Chamba men would only work regularly, I should employ them only; but as I have said they are too well off. After working for a week it becomes necessary for them to go home for a marriage or a "mela," and thus they are not to be depended on. The number of local sawyers is, however, yearly increasing, as they find the work pays very well, and their sawing is improving, so that in time it is hoped we shall be independent of outsiders, who are apt to make a flitting with their advances to the grief of the contractor. In another way our works have an excellent result, and that is, the villagers can now saw up trees given for building instead of as heretofore, hacking them with axes; in this way there is great economy of timber to the benefit of the forests. Another point in favor of local men is that they do every part of the

work themselves; fell the tree, cut the logs, and erect them for sawing; the Amritsar men can only saw, all the [illegible] be done for them by others. Still, at present [illegible] and they do more, as they are too far away to want leave to [illegible] homes at any time in the season.

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There is shooting to be had on the Sao valley [illegible] "gural" on the steep grassy slopes, serau ("jang[illegible]" in Cha[illegible] in the dark sheltered forests; in the higher elevat[illegible] there are many "monál" and argus ("nil" and "phulgar"), and of course "koklas" and "kalij" ("kokrola" and "kolsa") pheasants lower down. There are also woodcock to be found now and then, but very few; these are driven down to Chamba when there is a heavy fall of snow, and in 1882 no less than 68 of them were shot in and around the town in one or two days. The ferns are the ordinary mid level ones, the rarer being *Polypodium membranaceum*, *Notholæna vellea*, *Aspidium Thomsoni* and an *Asplenium (Athyrium)*, which I have only just found. I am told this is *A. macrocarpum* var. *Atkinsoni*, but am doubtful, as it is not at all like the specimen I have from Darjeeling, where it is very common. As yet I have only seen it in this one place, growing on a steep cliff almost out of reach, at a spring strongly impregnated with iron. It is curious how local some of the ferns are in Chamba, thus, I have only found *Asplenium pekinense* on one rock near Chamba, *Pteris Wallichiana* at one spot in Majaur forest, *Polypodium Stewartii* on one rock above Alwas, *P.* (*drynaria*) *rivale* on a single tree up the Sao valley, *Cheilanthes Szovitzii*, a single plant only, near Sach in Pangi, and yet I have been several years here, and have always kept a good look out as I walk along.

From the forest house at Chatri down to Kalel, there are two roads or paths, both made by the Forest Department; by one, which runs through the Sikri forest, it is about 7 miles; by the other below the Rupani forest a mile or so less. This latter is much steeper, and not as good as the other; both pass through a very pretty country. A curious accident happened on the Sikri road last year, where it descends a steep hill by zigzags. There was a great mass of snow lying on the hill-side, and while two villagers were going down over it, the whole mass slipped down and buried them at the bottom of the hill; one man managed to extricate himself, but the other was so deeply covered up that he could not be got out for several days, and was of course dead. It happened in March, when the snow was melting and liable to slip at any moment, so the men should have known better than to expose themselves to the danger. By the way, Mr. Editor, can you or any of

your readers give me an authority for the word "lavine," meaning a snow-slip like the above? Some one gave me the word with that signification, but I have never met "any other buddie," as Dr. Stewart used to say, who had ever heard the word, nor can I find it in any dictionary. At Kalel there are two encamping grounds, one the public one down by the stream in a very hot confined valley; the other half a mile higher up on an open spur called Gutkar, here a forest house has just been built, which will be very useful to Forest officers and travellers. The only drawback is the distance from which water has to be brought, but this is compensated by the cool situation compared with Kalel. In a former contribution was mentioned the Chamba sandal ("chapli"), and I was rather disposed to decry it as a form of foot-gear, but subsequent experience has led me to form a better opinion of it, and I now use nothing else in dry weather. They are more comfortable than boots, which are apt to produce blisters on a hot march with much up and down hill walking. The local "Watts" too has improved in the manufacture, the sole is now made of good stout buffalo leather, and if the "stockings" are sewn with leather instead of thread, they last a very respectable time, and at Rs. 2-4 each in these days of a debased coinage, are much cheaper than English boots. It is quite astonishing what a number of people have taken to them, they now go to such places as Cawnpore, Ajmere, and lastly Upper Burma. In this respect the country shoemaker can beat the English one, for I tried the experiment of getting a pair made by a London bootmaker, and not only did they not last half the time, but the cost was about eight times that of the Chamba chaplis. While on the subject of gear might be mentioned a form of nether garment, which I have found to surpass all others for hill walking; it is something like that worn by native infantry regiments, and consists of knickerbockers with gaiters attached. While wearing this one has all the freedom at the knees which knickerbockers give, without the heat produced by long stockings and the extra gain that nothing can get into the boots while walking. A buckle below the knee prevents slipping down, and if made of khaki drill, it is the best form of trouser for hill walking in the summer. The great thing is the freedom at the knees, and those who have done much steep walking will understand this. The hill people do, for they wear a garment which is exceedingly free, not to say baggy, at the knees.

But, to resume (a phrase considerably shorter than the hackneyed French equivalent) the next march is from Kalel to Tisa, 12 miles or so. The first part for some miles is an admirable road,

scientifically laid out by a European years ago, and contrasts most favorably with the ancient road made, I believe, to my sorrow be it said, by the Forest Department. The present road ascends at an easy slope from the Kalel nala, and then proceeds on a level, with steep cliffs above and below for several miles, and then descends gently to the Tikri nala. A friend (G. W. B.) had a strange experience on this part of the road in 1884. I must premise that he is a great shikari, and the height of his ambition for years past had been to shoot a leopard, and he had never succeeded. He was returning to Chamba from Tisa, and had with him two fox terriers, the remnants of a pack which had gradually disappeared by natural and accidental deaths; as there was apparently no chance of game between the Tikri nala and Kalel, he had left his rifle some distance behind, and was jogging along with the dogs in front of him. Suddenly a huge leopard sprang out of some scrub above the road, caught up one of the dogs and ran down into the bushes below; B. shouted and did all he could to make the leopard drop the dog but without avail; the other dog barked and finally ran after the leopard into the jungle, and B. could hear its bark getting fainter and fainter, and could make out that it was evidently steadily following the leopard. He and a peon went down and shouted and threw stones without effect; finally he heard a sharp yelp and then silence, and he never saw his dog again. Thus in a few moments he had missed bagging a leopard, never having had such a splendid chance, and had also lost the last of his dogs! The second dog must have followed out of sheer affection for the one taken by the leopard, as the two were very fond of one another. B.'s feelings may be "better imagined than described." At about 2 miles from Kalel the road passes under a great precipice, where I had a narrow escape some years ago, one rainy day, a huge stone falling on the road, breaking it away so as to be almost impassable, within 50 feet of me; luckily I was walking, having just dismounted, but my pony very nearly went over the khud from fright. After crossing the Tikri nala the road ascends towards Tisa, finally crossing the Bagota nala over the remarkable chasm before described (Chamba trip), 20 feet wide and 160 feet deep. On the whole this is a nice march, and can be done within five hours going at an easy pace. The only notable fern to be found on the road is *Gym. vestita*, rare in Chamba, which grows on some dry rocks above the road. At Tisa *Cheilanthes fragrans* is very common, growing out of the walls supporting the edges of cultivation. Tisa is a very uninteresting place, a large village for Chamba, with a "kothi" built on a

barren hill-side and very hot in summer, though at an elevation of about 6,000 feet. Sand flies are particularly bad in summer. There is a forest house here, a fairly comfortable one, much appreciated by travellers who have been long in tents. A hospital has lately been built by the Raja of Chamba, which will be of great service to the surrounding villages, as this is the most populous district in Chamba.

The next march from Tisa to Alwas is 12 miles, and a fairly easy stage. The road first ascends a steep ridge behind Tisa, by hot and dusty zigzags, but shortly after runs nearly level, and passes through the small (deodar) forest of Dauri, which affords grateful shade and some pheasant shooting. The upper part of the forest, which was once a grass blank, was closed to grazing, and partly planted with deodar, and natural reproduction having also succeeded, it is now a dense thicket of nearly pure deodar, almost impenetrable in places, and a favorite resort of black bears when the millet crops are ripe in the adjoining fields. Onwards the road runs almost level for about 4 miles, till it rapidly descends into the Baira nala. The left bank of this stream is shady and moist, covered with a dense growth of nettles in the lower parts, (*U. dioica* and *urens ?*) which supply nearly the whole district with fibre for rope-making, and are also used as a vegetable. Their medicinal properties do not appear to be generally known, nor does the yellow dye yielded by the roots when boiled with alum appear to be used in Chamba. Beyond the Baira nala the road mounts up a steep grassy ridge to avoid precipitous ground along the Alwas stream, which flows through a deep chasm some hundreds of feet below, and passing at a fairly level gradient through the village of Sarwas, gradually descends through a shady bit of broad-leaved forest of walnut, maple, &c., to the water's edge. A nice little wooden bridge spans the stream at Trail, and the level space on the bank of the stream makes a pretty and convenient place for breakfast if an early start has been made from Tisa. The four miles of road from Trail to Alwas are capable of much improvement; from the bridge the road rises by steep zigzags to the village of Kokru, and then goes slightly downhill to Salog, while it might easily have been taken nearly level onwards, and thus avoided several unnecessary ascents and descents towards Alwas. A grove of fine deodars surrounding the temple of the Nil deo above the road is a prominent feature of the scenery beyond Salog. This god is the local clerk of the weather, and is propitiated by being bathed in milk and besmeared with *ghi:* a slight fall of snow or even rain elicits a cry of "Ai Maharaj"

from the coolies who are passing. Alwas is a pretty camping ground on a gentle slope above the junction of two streams, the Sarunda and Wang, and surrounded by firs and oaks. An evening stroll into the forest with dog and gun is generally repaid, as koklas and monál are numerous. Black and brown bears are also to be got in the Sarunda nala, and the local shikari, Binoo, lives close to the encamping ground, and is always ready to show their haunts.

From Alwas the next march to Salrundi is a fairly easy one. Salrundi is merely a camping ground, known as "haliás" in these regions. If pressed for time the traveller would not halt here, still a halt is well repaid, for the scenery is grand, and there is a charm in being up in this region of mighty mountains covered with eternal snow. The road rises steeply from Alwas, passing at first through mixed forest, then through a belt of pines, and finally emerging into the treeless upper region, which during the summer is a beautiful sight, the grassy slopes being carpeted with flowers of every hue. Midway there is a large nala, called the Bhujopur nadi, and in this are to be found several good ferns—*Cryptogramme crispa*, *Pellea gracilis*, *Nephrodium Barbigerum*, *Brunonianum* and *odontoloma*, *Aspidium Prescottianum* var. *Bakeriana*, and on a rock at the side of the road *Polypodium Stewartii*, also some varieties of *Asplenium* (Ath.) *filix fœmina*, such as *attenuata*, *dentigera* and *retusa*. Above and below this nala are a number of open spaces, known as "góts," which are good places for the brown or snow bear, in April and September, and of course hereabouts, in the forests there are many monál and argus pheasants and snow partridges and pheasants. Salrundi lies at an elevation of about 11,000 feet, the Sach Pass being 14,328 feet. There is a hut under a mighty rock, but as it is used by shepherds, no civilized being can stay in it owing to the vermin which infest it. The Sach Pass is the easiest in Chamba, a pony can be ridden nearly the whole way to the top when the snow has melted in August. Perhaps the best time to cross is in June, when the snow is hard, and extends for some miles below the Pass on either side. From Salrundi to the Pass there is no road to speak of, as the snow obliterates it every year, but there is no difficulty in getting to the Pass except that on the last few hundred feet steps have to be cut in the hard snow. Towards Dalhousie there is a grand view of mountain and valley, but on the Pangi side there is nothing to be seen, as the valley is a very narrow and winding one. The Sach Pass can be crossed up to about the 15th November. The descent to Donai is steep, in May and June the road

lies over hard snow all the way, but in August the snow does not extend so far, and the path is a very hot and dusty one. The rare ferns on this road are *Adiantum pedatum*, *Asplenium fontanum*, *Polypodium dryopteris* and *Pellea gracilis*, the last having a very pretty delicate frond. Donai is a wretched place to camp at, being situated at the junction of two nalas, down which a very cold wind blows; attempts have been made to build a forest house here, but the avalanches have been too much for it, and nothing now remains but a few pieces of stone walling. The final stage into Kilar is about 10 miles long, and is an interesting march, as the road passes through some wonderful scenery. From Donai it gradually descends to a bridge which spans the main nala; after crossing this there is a steep ascent with several turns up into the Kalatope forest. The cliffs at this place rise to a very great height; standing on the centre of the bridge and looking up they actually appear to overhang, and as the bridge is perhaps 200 feet above the water, the cliffs cannot be much under 1,000 feet from top to bottom. This is a really sheer drop, not merely a precipitous slope; one often hears of so-called perpendicular cliffs of 2,000 feet and over, but it is difficult to conceive such a thing, and if they could be measured, it is probable they would be found to be much less. This part of the valley is exceedingly rugged and steep, everywhere stupendous cliffs and very steep hill-sides with little but grass on them. Along these cliffs are to be seen many "kart" or "tahr," and it is perfectly wonderful how they can dash along at the pace they do. Brown bears are also to be found in this valley, both in spring and autumn. Between Donai and Kilár there are not many ferns worth taking, except those mentioned above, and *Asplenium septentrionale*. After passing through the Kálatóp forest, where the road is steep, first up and then down, the Kilár bridge is reached. This spans the Chenab river (here known as the Chandra Bhaga). This bridge is the usual "sangla" of these hills, being built of wood; the beams are supported by struts on either side, and it has a planked footway and hand rail. The span is nearly 200 feet, and the bridge is 120 feet above the water. These structures last very well for 10 to 15 years, but after that they become dangerous, the centre beams having sagged to such an extent that they have to be taken up and reversed. Before British officers came to Pangi the river was crossed by a "jhula" or twig bridge. A word of explanation as to the construction of these may not be uninteresting to such as have not seen them. In Pangi they are generally made of birch, cotoneaster and Parrotia ("killar"). They do not last

more than one year, and moreover require to be repaired after every four months. For a span of 200 feet or so the cost is Rs. 10 only, and the work of construction occupies fifteen men for a week. There are two methods of construction, one in which the guy ropes pass through holes in posts, and in the other they are taken over horizontal beams or logs about 2 feet above that on which the foot-rope rests. Three large ropes or guys are used, one in the centre, which forms the footway, and one on each side some feet above the first. These guys are connected by stays along their entire length, forming a sort of netting, which is not however sufficient to prevent a man falling through. The guys are made of green twigs plaited together in fours, forming a slender strand, and six of these are twisted together into a large rope, too large to be tightly grasped, so that one has not much hold on them in crossing; the foot-rope consists of five strands only. The twigs are gently heated to render them sufficiently pliant to be plaited properly together. One man puts the twigs together, another heats them, a third does the plaiting, and a fourth keeps it tight by means of wooden pins, at the same time stretching the rope as it is made. The large ropes are completed on the river bank, and then the work of getting them across begins. Men have to get to the other side of the river, and to do this they have often to walk miles up the river bank over most precipitous ground till they get to a crossing place. It is quite impossible to cross such a river as the Chandra Bhaga, through the water, not only does it rush along at a great pace, but the water is icy cold. Having reached the opposite side, endeavours are made to throw over a line to which the rope is attached. This is sometimes done by firing a bullet, to which a thin string is attached, but where no gun is available they have to throw, from both banks simultaneously, lines to which wooden grapnels are fixed and try to hook on in the water; having done this they proceed to haul the large rope across, and this has to be managed with great caution, only a short length being paid out at a time; if it were to fall into the water they could never haul it through the swiftly running river. Once landed, the guys are made fast separately round the nearest trees or large stone and securely fastened. The three ropes are then connected together with stays, and the bridge is finished. The whole structure has an airy, unsubstantial appearance, and crossing it is by no means an easy task; the footway is merely the large rope with no sort of staging of any kind, in fact the process is slack-rope walking of a very nervous kind, especially as there is a rushing flood 80 to 120 feet below. To

add to one's nervousness, the "jhula" has an unpleasant habit of swaying both up and down and sideways while being crossed, so that a very steady head is necessary to go across, and very pliant foot-gear, no one could do it in ordinary boots. From the bridge, the road is steep till it reaches a level with Kilár, this can be ridden, but most people would prefer to walk, as there is a very nasty drop towards the river.

Kilár is the capital of Pangi, to dignify it with a grand name, for it is merely a village, with the Raja's "kothi" and the forest house. The latter is a curious old patchwork structure, part being like a native house and part in English style. It is surrounded by very tall poplars, and has an excellent vegetable and fruit garden, especially one English apple tree, which now produces some hundreds of magnificent fruit. Hops were introduced into Pangi in 1880 and thrive very well, they are grown mostly in the Raja's land adjoining the kothi, but apparently the villagers find it is a remunerative crop, for they have taken to its cultivation in one or two places in the valley. The staple crops are barley, wheat and millet, &c. Indian corn is not grown, the snow fall interferes with its cultivation, and the bears do too much damage. Potatoes were introduced by English officers years ago, and are grown in many villages. The country immediately around Kilár is very bare and ugly, the only noticeable feature, close at hand, being a pretty grove of deodars. The view up the Chandra Bhaga is very grand, mighty snow-clad peaks in the distance, and in the foreground masses of dark stupendous cliffs. At the back of Kilár is a high barren peak, where marmots are to be found; they afford a very good hour's sport with a rook rifle, and their skins are well worth the trouble of the climb.

Owing to the forests having been overworked in the dim past, there are very few mature deodar trees now left, and the future fellings will be limited to a few hundred once in every five years. Although there are not many trees fit for immediate cutting, still in thirty years or so the number will be very large, as the growing stock is in very good condition. The natural reproduction of deodar is excellent, since the Forest Department stopped the fires that used to be yearly lighted without any restriction. Some plantations have been made, but the valley is unsuited to artificial measures owing to the scanty rainfall, and the efforts made have resulted in failure, partly from this cause, but mainly from the unsuitability of the localities where the experiments were made, thus, in one place much time and money were expended on endeavouring to plant up a piece of old river bed, the soil consisting princi-

pally of sand and boulders. Owing to the cessation of regular working, no forest officer now lives at Kilár, nor is it likely there will be one there for many years to come, whatever works have to be carried out will probably be under the charge of a subordinate, supervised by the Chamba officer. The climate of Kilár (8,411 feet) is very mild in the summer, rarely rising above 80 degrees; the rainfall is slight, not exceeding 30 inches, so that if the place were only more accessible to invalids, it would be well suited to them; many travellers have likened the summer to that of England with the same softness in the air. Pangi used to be a regular hunting ground for ibex, and many English sportsmen came over in the spring, but the well-known places have been too much shot over, especially the once famous Tuan nala, and it is doubtful if an ibex with horns much over 32 inches could now be found. The Raja of Chamba has wisely closed this nala, for the present. There are however, many black and brown bears all over the valley, and as Pangi is easily accessible to sportsmen, more so than Kashmir, visitors usually find that even short leave of two months can be very enjoyably spent in tramping over hill and dale.

J. C. McD.

CHARCOAL FOR GUNPOWDER.

ENQUIRIES have lately been made as to the possibility of making charcoal for gunpowder from Indian species of *Cornus*—dogwood.

There are three species fairly common in the outer hills of the Himalayas, namely, *C. macrophylla*, *C. capitata* and *C. oblonga*, but the cost of transport to the plains would be great. It would be an advantage if a good substitute for dogwood could be found in abundance in more accessible regions in India, and the subject is one well worthy of an exhaustive enquiry.

The following plants are at present in extensive use for gunpowder charcoal in India.

The common shrub *Justitia Adhatoda*, which is called baheker in the Punjab and bansuti in the North-West Provinces, is used for gunpowder charcoal in the Punjab.

Also the lower part of the stem or the root of *Calotropis gigantea*, a desert plant, is used to our knowledge in the Punjab. Colonel Drury, in his Useful Plants of India, in 1873, also says, page 101. that the root is used in the manufacture of gunpowder charcoal.

Next, it is said that the stalks of the cotton plant (*Gossypium herbaceum*) are also in use.

Lastly, we are told that the Madras Government Gunpowder Factory make use of the stalks of dál (*Cajanus indicus*), (kandi papu in Telugu and arhar dál in Hindustani.) The stalks are delivered at the factory with the surface well smoothened. Colonel Drury says, page 95, that *Cajanus indicus* stalks are used for making charcoal required in gunpowder manufacture (W. Elliott). Fire is also easily produced by friction from the dried stem.

In the above four plants we have thus inexhaustible material for the manufacture of charcoal for gunpowder. If any of them proves equal in quality to dogwood, there is no need for the latter.

This question should be decided by the gunpowder factories. It is not so easy to decide it elsewhere, because the manufacture of charcoal for gunpowder requires great care, the quality of the charcoal being very much influenced by the mode of carbonization and the temperature.

In England the chief woods used are the willow, the alder and what is popularly known as the "black dogwood," but which is really the alder buck-thorn, or berry-bearing alder (*Rhamnus frangula*), (Spon's Encyclopædia, page 882.)

The adoption of the above woods in England was no doubt decided empirically, for it is not easy to determine why any particular woods are better adapted than others. Though various other woods are used for coarse-blasting powder, the three named are generally selected for the best gunpowders.

Small wood, of about ten years growth, is in all cases preferred for powder-making. Alder and willow of this age will be probably 4 to 5 inches in diameter; dogwood about 1 inch. Alder and willow in pieces 3 feet long, not less than one or more than 4 inches in diameter. The wood must be straight, perfectly sound and entirely free from bark, and must have been felled during the spring of the current year. All wood is stacked on iron sleepers or on rows of brickwork. The dogwood is covered with straw thatching.

The wood is placed into sheet-iron cylinders, and these again into cast-iron retorts, three of which are heated together in a furnace. When clear carbon monoxide flame appears, the process of heating is stopped. The iron cylinders are taken out of the retorts and placed into iron extinguishers, in which the charcoal is cooled. The heating process lasts about three hours. Very much depends upon the temperature, so that even pyrometers are used for regulating it. Underburnt charcoal is highly inflammable. Charcoal prepared at 260° Centigrade ignites at 338° C., but if prepared at

982° C. charcoal ignites near 676° C. The more inflammable charcoal produces a more active or violent powder. Underburnt charcoal has, therefore, found favor for some small arms powders.

The following are analysis of several kinds of gunpowder charcoal :—

	Ash.	C.	H.	O. with trace of N.
Alder, ...	1·24	87·00	2·97	8·78
Willow, ...	2·02	85·82	2·88	9·28
Dogwood, ...	1·71	83·80	3 28	11·21

The average densities of these charcoals are respectively 1·37, 1·39, 1·30.

The analysis of the ash of each of these woods was as follows :—

	Alder.	Willow.	Dogwood.
Silica, ...	4·66	3·33	17·30
Phosph. lime, trace iron, ...	25·60	27·10	14·53
Lime, ...	24·90	27·66	31·60
Magnesia, ...	2·77	4·25	2·05
Potash, ...	10 53	11·50	8 20
Soda, ...	2·21	2·70	3·15
Sulphur trioxide, ...	1·20	2·50	1·22
Chlorine, ...	0·15	0·25	0·54
Carbon dioxide, ...	27·82	18·68	20·62
Total, ...	99·84	97·97	99·21

Experiments were also made (according to Spon's Dictionary) by mixing saltpetre and equal quantities of the charcoals of various woods which were burnt together. 12 gr. charcoal with 60 gr. saltpetre gave the following proportions of gas in cubic inches :—

	Cubic inches of gas, *mean*.		Cubic inches of gas, *mean*.
Elm, ...	62	Willow (*Salic alba*), ...	77
Oak, ...	62	Alder, ...	74
Mahogany, ...	58	Filbert, ...	72
Willow (overheated), ...	63	Fir, ...	66
Oak,...	55	Chestnut, ...	66
Buck-thorn (*Rhamnus frangula*), ...	82	Hazel, ...	66

This last table shows that good charcoals are those which develop most gas. Beyond this no definite rules exist about the qualities of woods suitable for gunpowder charcoal. Only there is a tendency to younger wood and to shrubs. The latter particularly in India. It is, however, possible that amongst the enormous number of full sized Indian trees there may be one, or another, the wood

of which may be of excellent quality for making gunpowder charcoal. The necessity for enquiry seems certainly indicated. For the present a few woods have been selected at the Dehra Dun Forest School for experiments, namely—

Adina cordifolia,	*Butea frondosa,*
Randia dumetorum,	*Holarrhena antidysenterica,*
Gardenia turgida,	

also charcoal from the species of *Cornus* already mentioned, is being prepared in Jaunsár, and specimens of each kind will be sent to the Kirki factory for report.

TREATMENT OF BAMBOOS.

With reference to Mr. Mendes' note on the 'Reproduction of Bamboos' in the December Number, I should like to be allowed to ask him to give your readers some information as to the data upon which the seven propositions he has made have been based. I have read them over carefully, and have been particularly struck by his adoption of arbitrary figures, for instance—

Proposition 1. Why 25? why not 20, or 30, or any other number? and can he show that in any species with which he is acquainted, clumps of 7 years possess usually 25 halms. I imagine the species he is referring to is the *Dendrocalamus Hamiltonii*, the common bamboo of the Darjeeling lower hills, which, I believe, extends into Assam eastwards, but is otherwise only of very local importance. Has Mr. Mendes carefully planted this bamboo (or whichever one it is) and recorded his observations on the number of shoots sent up the 1st, 2nd, 3rd and subsequent years from definite experimental clumps? If so, the record of his observations would be valuable, and I hope he will give it us. It would be a valuable basis for working plan calculations if it could be shown that, *even on an average*, a 7-year old clump of a particular species may be expected to give 25, or any other number of full-size halms.

Proposition 2. Here again, why 8? why not 5, or 10, or 15, or any number up to 25? Why also should each stem be 7 inches in girth? What species does he refer to, and has he made any experiments to show that 7 inches is the average girth of mature halms of that species, measured at such and such a distance from the ground? I take it, 8 is the number arbitrarily suggested as being one-third of the number of halms.

Proposition 3: Here again, is it not intended to say 'one-third of the number of halms'? Has Mr. Mendes taken any steps to

estimate the 'average growth per clump per year,' by which I take it he means the 'average yearly increase in number of halms'?

Proposition 4. Does 2½ feet in height correspond, in any particular species, to three nodes length? If so, in what species? The fact is, that in most bamboos I have come across, and particularly in *Bambusa*, the internodal spaces at the base are considerably shorter than those higher up, and very variable in their own length, and therefore to give the height at which a halm should be cut at so many nodes from the ground, would be liable to mislead. And why does Mr. Mendes fix upon 2½ feet? I believe I have, myself, occasionally, arbitrarily fixed the height at which bamboo halms should be cut, at a maximum of 6 inches or 1 foot, I do not quite remember which, but my object was to secure *low* cutting, while Mr. Mendes appears to wish to secure *high* cutting. Can he tell us why he wishes to cut halms at above a cubit in height. I should have thought that such a practice would be rather wasteful, and would leave unsightly stumps to rot off and propagate fire when dry; but possibly he has good reasons for his views.

Proposition 5. Mr. Mendes is probably right in fixing three years of age as the maximum age for cutting, but it would be interesting to know what his reasons are; and also if he has really ascertained by observation that the cutting of the first year's shoots kills the clump, in any particular species. Sir D. Brandis, in a most useful note, incorporated under *Bambuseæ* in Hackel's account of the Grasses in a newly published part of Engler and Prantl's 'Naturlichen Pflanzenfamilien' says that "when one cuts away all or too many of the halms of a bamboo-clump the rhizome is weakened. It then brings out for a series of years, only thin stems, until continued activity has again strengthened the leaves," and this accords with my own observations, which in the case of *Bambusa arundinacea* are distinctly that when the whole clump is cut down, thin twiggy shoots only are produced for a year or two, but afterwards these get gradually stronger and eventually big halms appear again as before.

Proposition 6. This seems quite right, but the reasons should be given. The removal of dry stems and stumps will prevent fire doing more damage than can be helped; and will give space for new halms to develop in; besides making it easier to cut marketable ones.

Proposition 7. This too seems quite a proper provision.

The little piece of experience at the end of Mr. Mendes' letter is interesting, but it would be the more so if he could develop it and give an account of the observations upon which he based it. I am

inclined to think the generalization is rather hasty, and that there may have been other reasons for the better production of the planted clumps, such as better soil, more light, &c.

The fact of the matter is that the whole of our present knowledge of the life-history of the Indian species of bamboo, and of the sylviculture of the *Bambuseæ*, is very small, and we badly want experiment and the record of careful and protracted observation. I remember that, some years ago, under the orders of Government, at the time of the discussion of Mr. Routledge's proposals to utilize bamboo shoots for paper stock, two sample areas were planted at Bamunpokri in the Darjeeling Terai, one of *Dendrocalamus Hamiltonii*, the other of *Bambusa Tulda* (I think). Perhaps Mr. Manson, who did the work, took some notes on the development of the clumps which, I believe, reached working-size in about five years, and noted the number of shoots produced in successive years. At any rate I may suggest that, as Mr. Mendes is interested in the subject, he should ask permission to make a new experiment in a proper locality and record results. He cannot expect that any one should supply him off-hand with a set of definite rules for the management and working of clumps, to be applied to all species and generally. Even the three-years' rule would sometimes require to be modified, as, for instance, when the demand is for basket materials, for basket makers usually require young and comparatively soft stems to work with. It will be very useful to have the whole subject discussed in the 'Forester,' but it will be still more useful if those who have made definite observations and experiments will record the results statistically. The species which it is most important to observe are—(1), the male bamboo, *Dendrocalamus strictus*, of the dry hills of the North-West, Central and South India; (2), *Bambusa arundinacea*, the thorny bamboo of the valleys of the Peninsula; (3), *Bambusa Tulda*, the common Bengal bamboo; and (4), *Dendrocalamus Hamiltonii*, the common, but poor, species of the Eastern Himalaya.

KEW,
12th January, 1888.

J. S. GAMBLE.

DATE CULTURE.

THE following is an extract from a letter by Dr. Bonavia to a friend in this country :—

"I am very glad to find that you have started experiments on date culture. Depend upon it a great deal can be made out of this tree, in

various soils and localities. It would be advisable to try some of the seedlings under various conditions—such as on the banks of canals and water-courses—on the edges of salt lakes, on drier irrigable land, and on dry unirrigable land; in order to ascertain what soil and conditions are best suited to it. Like all other fruit trees, it will bear a great deal of cultivation, and the more care is given to it, the better and larger the produce. In Egypt they manure largely with pigeon droppings, but any rotted manure will do. When the trees begin to fruit, manuring and care produce choicer fruit as might be expected.

"I have been exploring the literature of the date tree, principally in connection with its cultivation in Northern Africa. It is wonderful to see what has been done. All the information I have collected I have recently submitted to the Government of India. There is no doubt of success in many parts of India, provided the scheme is kept going for a number of years, and the interest in this important subject not relaxed. The point is to keep it going by the aid of Government sufficiently long to enable natives to see the result. Then they will carry it on without much supervision out of self-interest.

"It is marvellous to read what the Arabs and Berbers have done with this tree near the salt marshes of South Tunis and Algiers. Trees are to be counted there by millions, the people living upon little else than their fruit.

"In certain places they have to draw water by camel-power from wells of great depth, in order to irrigate their date trees.

"In Rájputána, I fancy in many places water is to be found at comparatively short distances from the surface. Near rivers, streams and tanks, the roots would soon go deep enough to be independent of surface water; but at first while the trees are growing, and until they are established, a good deal of care should be given to them.

"In Egypt, the date tree has been associated with man for upwards of 3,000 years, and it is wonderful to see how this tree has adapted itself to almost any soil and conditions. They have many varieties; some on dry soil, which is not irrigated; some on soils which are irrigated; and others on low ground, subject to Nile inundation. Some do well on sandy soil, and some on clayey soil, and so on—like the rice plant in India, cultivated from Ceylon and Burma, to the Himalayas and Afghanistan, owing to association with man from a very remote period; the date tree for similar reasons, has had time to adapt itself to various conditions—through propagation by *seed*. This appears the only way to get *new* varieties, that may be suited to different conditions. When India becomes well stocked with varieties of date trees, then there will be no difficulty in propagating only those which are best, by means of offsets.

"In correspondence with the Canal officers of Egypt, I have obtained a vast deal of information about the date tree, which I placed at the disposal of the Government of India.

"The Nile inundation lasts for three months or more, from beginning to end (commences in July—in September it is all over the country, attaining its maximum in Cairo in September, and early in November it is over). You see this is exactly the time between *setting* of the date fruit and *ripening;* and Egypt is then as damp as the rains in the North-West Provinces of India, so we must give up the notion that the date tree cannot succeed *except* in a *desert* climate. It should be noted however, that in Egypt, the fruit that keeps best after gathering is that from kinds that grow on high land, away from the Nile inundation. This is natural.

"But just fancy some kinds on the low lands doing well, with their roots under water for *70 days* without injury to the crop! From 20 to 70 days under water is ordinary, and some kinds do not produce well *without* inundation.

"There is no doubt whatever that the *varieties* of dates are infinite, and although it is only the choice and keeping varieties that are exported, *all* varieties are fit for feeding the people, either in their *ripe* state, or in their *unripe* state, and prepared in various ways.

"In their astringent state (red or yellow) and before they sweeten, dates in Egypt are sold in the bazaars and *eaten by the people.*

"So altogether this tree is a most hopeful one for the needs of India, not only in the drier, but also in the damper, tracts. I hope you will not drop the matter, as it is a very promising one. If it do not succeed in one place, it is a sign I think, that sufficient attention has not been paid to its needs.

"Where water is available, either in the subsoil or on the surface, it might do all over India.

"The best Egyptian dates are—

(*a*). *Ghazalee, Hayanee, Amree, Aklawee*, Bayd-el-Gamal, Binbaysha and Eglain; in the Sharkieh province (on dry land).

(*b*). *Samani, Zaglool* and *Halawa;* in Rosetta province.

(*c*). *Sultanee* and *Gunganee;* in Gabbari and Ramleh provinces.

(*d*). *Abreemee, Sukkutee* and *Goundela* from Sukkut, Upper Egypt.

(*e*). *Sewee*, from Sewa frontier of Bengasi.

"*N.B.*—The trees planted in the Sharkieh province, and that bear the best fruit, are on dry land, but there filtration of water to the roots is probable, as the roots go to great depths.

"Those planted in Rosetta, Aboukir, Ramleh and Gabbari, are all in a damp atmosphere, and damp soil, and *bear good qualities of fruit.*

"In Egypt, therefore, is a choice of varieties to suit all conditions of the various Indian climates both dry and damp, and I hope the Government of India may see fit to obtain also Egyptian variety of seeds. Regnier, in his observations on date cultivation in Egypt, says, the seed sometimes produces bastard varieties, but *more frequently pro-*

duces the parent kind. Of course the most certain way of reproducing the parent kind is by offset. That will come in due course, but at present variety and cheapness is of importance, and if done at all, it must be done largely and continuously for a number of years. The best way is to take nothing on trust, but to study the needs of the tree *in its new home.*"

THE CEDARS OF LEBANON.

THE grove of cedar trees on Mount Lebanon, which is mentioned in the Forest Flora of the N.-W. Provinces by Sir D. Brandis, was again visited in 1875 by Professor Dr. Fraas of Stuttgart.

From the town of Balbeck in Syria, with a temperature of 86° F. in the shade, he marched to the pass of El Adib, 7,825 feet above the sea, in the midst of melting snow with a temperature of 43° F. at 7 in the morning on the 23rd of May. Beyond this pass he came to the grove of cedars. The height of the grove above the sea is 6,332 feet, and the temperature fell in the night to 46° F., and did not exceed 68° F. during the day on the 24th of May.

The grove stands on the remains of an old moraine, which descended from the foot of Mount Makmel down the valley of Bsharreh.

Seven small hills of moraine débris form the site of the grove, which is quite isolated. With the exception of nine other solitary trees on adjoining ridges of glacial débris, there were near and far no other cedars, in fact no other trees nor shrubs, only deep down in Bsharreh cypress and poplar made their appearance.

The space occupied by the grove Dr. Fraas estimated at 25 acres. The total number of trees in the grove were 377. The largest tree stood along the rocky precipice of a hillock near the Maronite church. It measured 45 feet in circumference (at chest height). The traveller's tent stood beneath a tree of 30 feet circumference. There were altogether five trees with a circumference of 33 feet and more. The smallest trees had 3 feet circumference. A tree of 20 feet circumference had been killed by lightning, and on this tree Dr. Fraas counted the annual rings very carefully, and found 34 rings on 1-inch radius.

With this measurement as basis, the age of the biggest tree would nearly approach 3,000 years, and the five biggest trees would all exceed in age 2,000 years. The smallest trees would be 200 years old.

There are no young trees whatever, no advance growth. Dr. Fraas made a careful search for seedlings, but found none. Herds of goats which seek shelter under the cedars account for this. In the total absence of reproduction this last remnant of ancient glory appears thus doomed to annihilation. More than a score of stems show marks of lightning, and most of the large trees are severely damaged by the storms, and the trees are not as tall as they might be. One beautiful tree Dr. Fraas observed which was still perfect, 130 feet high, and containing altogether nine stories of branches. The last story was the well preserved top like an umbrella, not more in diameter than the base of the tree.

Foreign visitors have also damaged trees by cutting their names into them.

The local inhabitants would long have cut all the trees down if the very size of the trees was not a protection. It is beyond these people's power to cut such trees with their small tools.

A few isolated stems of other conifers are standing lower down as the solitary remains of demolished forests. These few trees evidently owe their preservation to their size.

Some oaks of 10 feet circumference remain standing for the same reason towards the eastern end of the Lebanon, where all younger trees are cut down.

In other parts of Syria the forests are likewise being utterly ruined by the cutting and mutilating of almost all trees. Dr. Fraas could not help attributing to this barbarism the complaints of the more and more frequent thunderstorms in winter and the increasing heat of summer.

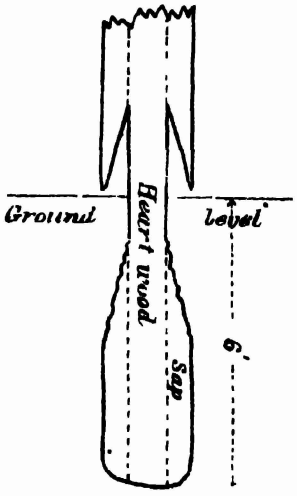
Dr. Fraas assumes also that there has been a general change of the climate which would prevent the future continuance of cedars in the Lebanon. We would not quite go so far. The climate is any how fit for the remaining cedars, and the absence of new trees has been sufficiently accounted for by Dr. Fraas himself. Further there is ample moisture, the snow having been 6 feet deep at the cedars in the winter preceding the visit. Moreover, the Lebanon rises far above the present level of the cedars, and situations with lower temperature are no doubt available.

We would, therefore, rather conclude that it only requires a period of peace, and preservation from goats and fires, and the cedars would spread again and flourish on Lebanon as of old. Solomon is highly esteemed by Mahometans, and some relic of the forests which furnished his magnificent temple should be as interesting to the Turks, as the tombs of their famous saints, which are so carefully preserved.

DECAY OF POSTS AT THE GROUND LEVEL.

I HAVE just unearthed 20 posts from a bungalow, built 10 years ago, and find the portions below 2½ to 3 feet from the surface as a rule quite good (even the sap-wood).

The decay at the ground line is so uniformly of the same character, that I forward an outline in case it may be of use in assisting towards an elucidation of this curse. Some few posts of ajhar (*Lagerstræmia Flos-Reginæ*) I find almost quite sound, and saw a case lately where an ajhar post, about 4½ feet girth, was absolutely sound to the very surface, all through round at ground, though it had been in for 19 years.



The peculiarity generally is that below 2½ to 3 feet the posts are generally quite good, even if of sap-wood of nahor (*Mesua ferrea*), why is this?

I have had some considerable experience in *re* posts, but have never been able to understand why even the sap-wood lasts below a depth of 2 or 3 feet, in a few cases the heart-wood was decayed at ground level, and sap-wood below quite intact. Can any of your scientific readers throw any light on the peculiarity, which is one that interests so many.

Neither kerosine, or petroleum, both of which are good for preserving upper work in doors, are of any use apparently at ground level, and packing round the foot with charcoal equally useless; sand ditto.

A white, thread-like, mycelium seems to infest the decaying portions, but why it should spare the part above ground, when it luxuriates among our tea tree stems, exposed to weather and *sun*, is an anomaly. I enclose some of the threads referred to.

Naharani Saw-mills, S. E. PEAL.
Sibsagar, Assam.

It is probable that at a certain depth below the surface, the mycelium of the fungus which destroys the wood cannot grow, for want of oxygen, and perhaps of sufficient humidity.

Above ground, it is probably killed by the heat of the sun and by exposure to the drying influences of the wind and air, which are less effectual amongst the crowded tea bushes.

The mycelium will be sent to Mr. Marshall Ward of Cooper's Hill College for inspection, and if Mr. Peal could forward complete specimens of wood attacked, and fructification of the fungus to that gentleman, and also to the Director Forest School, the nature of the fungus could be studied.—[ED.]

MAGNESITE AT MUSSOORIE.

I HAVE just visited the locality near the Happy Valley in Mussoorie, where magnesite occurs, and found three out-crops 4 feet thick, a mixture of a fine white powder and of coarser rock. The two can be separated by washing. I obtained 20 per cent. of the coarse rock, which is a dolomite containing about equal quantities of magnesium carbonate and calcium carbonate. The white powder amounted to 80 per cent., and by chemical analysis I found it to be composed as follows :—

Silica, &c., ...	6
Alumina, ferric oxide, &c., ...	3
Calcium carbonate, ...	7
Magnesium carbonate, ...	84
Total, ...	100

This is much purer magnesite than the specimen which I obtained in 1884, and of which an analysis was published in the "Indian Forester," March 1884. The vegetation prevented me from making a more extended examination, but as the out-crops look like the ends of a regular seam, there promises to be a sufficient supply for the requirements of a manufactory of wood pulp.

H. WARTH.

WE understand that a Conference is to be held at Delhi, at the end of this month, to decide the future organization of a Veterinary Department to deal with cattle disease, which has been so prevalent in the north of India. The question of the extension of the utility of the Dehra Dún Forest School will also be discussed.

JJ. Review.

TIMBER AND SOME OF ITS DISEASES.

We have before us the four last Numbers of 'Nature,' and we would strongly recommend all our readers to procure them, if it were only to read the papers on 'Timber and some of its diseases' by Mr. Marshall Ward, the Professor of Forest Botany at the Cooper's Hill College.

In a short notice like the present one, it is quite impossible to give anything like a correct idea of the clearness and simplicity of Mr. Ward's style, which is admirably illustrated by diagrams, and we need only add that the differences in coniferous and dicotylonous wood in spring and autumn zones, and the absence of well marked annual rings in woods grown in tropical climates, are clearly pointed out, as are the differences in woods due to bands of parenchyma, and distribution of pores.

The relation of the structure of wood to its specific gravity and its liability to warp, and the possibility of seasoning timber is clearly traced.

The effects of the environment on the activity of the cambium cells is gone into fully, and here we must quote a paragraph—

"First as to temperature. The dormant condition of the cambium in our European winter is directly dependent on the low temperature: as the sun's rays warm the environment, the cambial cells begin to grow and divide again. The solar heat acts in two ways: it warms the soil and air, and it warms the plant. Wood, however, is a bad conductor of heat, and the trunk of a tree is covered by the thick corky bark, also an extremely bad conductor, and it would probably need the greater part of the early summer to raise the temperature of the cambium sufficiently for activity in the lower parts of a tree by direct solar heat: the small twigs, on the contrary, which are covered by a thin layer of cortex, and epidermis, are no doubt thus warmed fairly rapidly, and their early awakening is to be referred to this cause. The cambium in the trunk, however, is not raised to the requisite temperature until the water passing up through the wood from the roots is sufficiently warm to transmit some of the heat brought with it from the soil to the cells of the cambium. This also is a somewhat slow process, for it takes some time for the sun's rays to raise the temperature of the soil while the days are short and the nights cold. Hartig has shown that the cambium in the lower part of the trunk of a tree may be still dormant three weeks or a month after it has begun to act in the twigs and small branches; and

it has also been pointed out that trees standing in open sunny situations begin to renew their growth earlier than trees of the same species growing in shady or crowded plantations, where the moss and leaf-mould, &c., prevent the sun from warming the soil and roots so quickly. These observations have also a direct bearing on the later renewal of cambial activity in trees growing on mountains or in high latitudes. Moreover, though I cannot here open up this interesting subject in detail, these facts have their connection with the dying off of temperate trees in the tropics, as well as with the killing of trees by frost in climates like our own. One important practical point in this connection may be adverted to. Growers of conifers are well aware that certain species cannot be safely grown in this country (or only in favoured spots) because the sun's rays rouse them to activity at a time when spring frosts are still common at night, and their young tissues are destroyed by the frosts. Prof. R. Hartig has pointed out a very instructive case. The larch is an Alpine plant, growing naturally at elevations where the temperature of the soil is not high enough to communicate the necessary stimulus to the cambium until the end of May or June. Larches growing in the lowlands, however, are apt to begin their renewed growth in April, and frosted stems are a common result, a point which (as the renowned botanist just referred to also showed) has an important bearing on that vexed question—the 'larch-disease.'"

And again—

"One of the most interesting experiments in this connection came under my observation this summer, owing to the kindness of Prof. Hartig. There is a plantation of larches at Freising near Münich, with young beeches growing under the shade of the larches. The latter are seventy years old, and are excellent trees in every way. About twenty years ago these larches were deteriorating seriously, and were subsequently 'under-planted' with beech, as foresters say—*i.e.*, beech-plants were introduced under the shade of the larches. The recovery of the latter is remarkable, and dates from the period when the under-planting was made.

"The explanation is based on the observation that the fallen beech-leaves keep the soil covered, and protect it from being warmed too early in the spring by the heat of the sun's rays. This delays the spring growth of the larches: their cambium is not awakened into renewed activity until three weeks or a month later than was previously the case, and hence they are not severely tried by the spring frosts, and the cambium is vigorously and continuously active from the first.

"But this is not all. The timber is much improved: the annual rings contain a smaller proportion of soft, light spring wood, and more of the desirable summer and autumn wood consisting of closely-packed, thick-walled elements. The explanation of this is that the spring growth is delayed until the weather and soil are warmer, and the young leaves in full activity; whence the cambium is better nourished from the first, and forms better tracheides throughout its whole active period. Such a result in

itself is sufficient to repay the investigations of the botanist into the conditions which rule the formation of timber, but this is by no means the only outcome of researches such as those carried on so assiduously by Prof. Hartig in Münich, and by other vegetable physiologists."

In Part III. of these papers which appears in 'Nature' of the 5th January, the question of the diseases of living trees and of timber is discussed, and Mr. Marshall Ward informs us that he has lately been able to visit one of the most instructive and remarkable museums in the world—the Museum of Forest Botany in Münich—under the guidance of Professor Robert Hartig—to whose brilliant investigations we owe nearly all that has been discovered of the diseases of trees caused by *Hymenomycetes*.

An account is given of *Trametes radiciperda*, which devastates conifers, and regarding the general symptoms of attacks on a plantation by fungi we quote again as follows:—

"Since, as we shall see, *Trametes radiciperda* is not the only fungus which brings about the destruction of standing timber from the roots upwards, it may be well to see what characters enable us to distinguish the disease thus induced, in the absence of the fructification.

"The most obvious external symptoms of the disease in a plantation, &c., are—the leaves turn pale, and then yellow, and die off; then the lower part of the stem begins to die, and rots, though the bark higher up may preserve its normal appearance. If the bark is removed from one of the diseased roots or stems, there may be seen the flat, silky, white bands of mycelium running in the plane of the cambium, and here and there protruding tiny white cushions between the scales of the bark, in advanced stages the fructifications developed from these cushions may also be found. The wood inside the diseased root will be soft and damp and in a more or less advanced stage of decomposition."

In Part IV. we have an account of *Agaricus melleus*, a tawny yellow toad-stool springing from the base of dead and dying trees in September and October, and very common in England.

This fungus has a mycelium consisting of dark shining strings, called rhizomorphs, resembling the purple black leaf-stalks of the maiden-hair fern, which branch in the wood of tree, and may attain a length of several feet.

This parasite produces a fatal disease in the attacked-timber trees, and spreads from tree to tree by its underground rhizomorphs, and hundreds of spruce firs in the Bavarian Alps have fallen victims to it.

Mr. Marshall Ward remarks as follows on the general utility of the study of fungi:—

"It is at least clear from the above sketch that we can distinguish these two kinds of diseases of timber, and it will be seen on reflection

that this depends on knowledge of the structure and functions of the timber and cambium on the one hand, and proper acquaintance with the biology of the fungi on the other. It is the victory of the fungus over the timber in the struggle for existence which brings about the disease; and one who is ignorant of these points will be apt to go astray in any reasoning which concerns the whole question. Anyone knowing the facts and understanding their bearings, on the contrary possesses the key to a reasonable treatment of the timber; and this is important, because the two diseases referred to can be radicated from young plantations and the areas of their ravages limited in older forests.

"Suppose, for example, a plantation presents the following case. A tree is found to turn sickly and die, with the symptoms described, and trees immediately surrounding it are turning yellow. The first tree is at once cut down, and its roots and timber examined, and the diagnosis shows the presence of *Agaricus melleus* or of *Trametes radiciperda*, as the case may be. Knowing this, the expert also knows more. If the timber is being destroyed by the *Trametes*, he knows that the ravaging agent can travel from tree to tree by means of roots in contact, and he at once cuts a ditch around the diseased area, taking care to include the recently-infected and neighbouring trees. Then the diseased timber is cut, because it will get worse the longer it stands, and the diseased parts burnt. If *Agaricus melleus* is the destroying agent, a similar procedure is necessary; but regard must be had to the much more extensive wanderings of the rhizomorphs in the soil, and it may be imperative to cut the moat round more of the neighbouring trees. Nevertheless, it has also to be remembered that the rhizomorphs run not far below the surface. However, my purpose here is not to treat this subject in detail, but to indicate the lines along which practical application of the truths of botanical science may be looked for. The reader who wishes to go further into the subject may consult special works. Of course the spores are a source of danger, but need be by no means so much so where knowledge is intelligently applied in removing young fructifications."

He then gives an account of *wound parasites*, or those which enter the wood by some wounded surface, a cut branch, torn bark, &c.

One of the commonest of these *Polyporus sulphureus*, which does great damage to standing timber, furnishes a type well known to all foresters in the tiers of bracket-shaped bodies like cheese, yellow below, and orange or vermilion above, which project from diseased trunks, and are common in Windsor park.

. The following extract is highly interesting :—

"I cannot leave this subject without referring to a remarkably interesting museum specimen which Prof. Hartig showed and explained to me this summer. This is a block of wood containing an enormous irregularly spheroidal mass of the white felted mycelium of this fungus, *Polypo-*

rus sulphureus. The mass had been cut clean across, and the section exposed a number of thin brown ovoid bodies embedded in the closely-woven felt: these bodies were of the size and shape of acorns, but were simply hollow shells filled with the same felt-like mycelium as that in which they were embedded. They were cut in all directions, and so appeared as circles in some cases. These bodies are, in fact, the outer shells of so many acorns, embedded in and hollowed out by the mycelium of *Polyporus sulphureus.* Hartig's ingenious explanation of their presence speaks for itself. A squirrel had stored up the acorns in a hollow in the timber, and had not returned to them—what tragedy intervenes must be left to the imagination. The *Polyporus* had then invaded the hollow, and the acorns, and had dissolved and destroyed the cellular and starchy contents of the latter, leaving only the cuticularized and corky shells, looking exactly like fossil eggs in the matrix. I hardly think geology can beat this for a true story."

The last paper on this subject appeared on the 19th January, and is devoted to the biology of *dry-rot*, the *Merulius lacrymans*, from which we give the following:—

"It will be evident from what has been stated that the practical application of botanical knowledge is here not only possible, but much easier than is the case in dealing with many other diseases.

"It must first be borne in mind that this fungus spreads, like so many others, by means of both spores and mycelium: it is easy to see strands of mycelium passing from badly-diseased planks or beams, &c., across intervening brick-work or soil, and on to sound timber, which it then infects. The spores are developed in countless myriads from the fructifications described, and they are extremely minute and light: it has been proved that they can be carried from house to house on the clothes and tools, &c., of workmen, who in their ignorance of the facts are perfectly careless about laying their coats, implements, &c., on piles of the diseased timber intended for removal. Again, in replacing beams, &c., attacked with dry-rot, with sound timber, the utmost ignorance and carelessness are shown: broken pieces of the diseased timber are left about, whether with spores on or not; and I have myself seen quite lately sound planks laid close upon and nailed to planks attacked with the 'rot.' Hartig proved that the spores can be carried from the wood of one building to that of another by means of the saws of workmen.

"But perhaps the most reckless of all practices is the usage of partially diseased timber for other constructive purposes, and stacking it meanwhile in a yard or outbuilding in the neighbourhood of fresh-cut, unseasoned timber. It is obvious that the diseased timber should be removed as quickly as possible, and burnt, at once: if used as firewood in the ordinary way, it is at the risk of those concerned. Of course the great danger consists in the presence of many ripe spores, and their being scattered on timber which is under proper conditions for their germination and the spread of the mycelium.

We give the following extracts from Messrs. Churchill and Sim's Wood Circular, reviewing the London Timber trade for the past year :—

London Importation of Wood, and Estimated Consumption.

	Of Sawn wood, or Deals, Battens, Boards, and ends, in pieces.							Of Hewn timber, Spars, Railway Sleepers, &c., in Loads.						
	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Norway, ...	1,418,000	1,215,000	1,198,000	1,150,000	613,000	588,000	655,000	5,400	5,000	9,300	6,000	4,500	4,700	4,600
„ *Flooring Boards,*	9,053,000	8,160,000	8,534,000	7,843,000	7,256,000	7,082,000	5,991,000							
Sweden, ...	7,078,000	7,073,000	6,574,000	7,656,000	6,591,000	6,293,000	5,601,000	7,700	2,100	1,900	3,600	5,400	3,400	2,800
„ *Flooring Boards,*	2,260,000	1,854,000	2,891,000	3,168,000	3,444,000	3,480,000	4,327,000							
Finland, ...	1,497,000	1,385,000	1,765,000	1,955,000	1,488,000	1,030,000	661,000	900	200	400	600	600	1,000	800
Russia, ...	2,087,000	2,744,000	2,876,000	3,048,000	3,862,000	2,918,000	2,874,000	70,700	77,500	65,400	61,100	41,000	49,000	40,000
Prussia and Germany, ..	64,000	108,000	64,000	38,000	192,000	154,000	26,000	83,300	87,500	105,700	78,700	68,600	27,600	54,600
United States, ..	108.000	43,000	148,000	106,000	145,000	187,000	70,000	19,000	18,300	21,200	32,200	27,800	17,400	9,900
Total Foreign Importation.	23,565,000	22,582,000	24,050.000	24,964,000	23,591,000	21,732,000	20,205,000	187,000	190,600	203,900	182,200	147,900	103,100	112,700
Estimated Consumption, ..	24,442,000	23,902,000	23,411,000	24,273,000	22,703,000	22,910,000	23,425,000	184,100	188,700	202,900	182,000	146,300	114,500	122,700
Canada, ...	3,661,000	3,014,000	3,735,000	3,685,000	3,633,000	3,929,000	2,793,000	17,700	18,000	17,800	18,300	22,300	11,200	11,600
New Brunswick & Nova Scotia, ...	1,104,000	695,000	988,000	355,000	510,000	503,000	184,000	2,900	2,000	2,700	4,200	3,300	1,700	1,500
East & West Indies, &c.,	..	..	..	..	..	..	..	15,900	7,300	10,200	16,000	12,600	19,400	9,100
Total Colonial Importation,	4,765,000	3,709,000	4,723,000	4,040,000	4,143,000	4,432,000	2,977,000	36,500	27,300	30,700	38,500	38,200	32,300	22,200
Estimated Consumption, ..	5,213,000	4,440,000	4 435,000	4,480,000	3,851,000	3,958,000	3,100,000	33,400	30,200	32,900	32,000	33,000	29,000	30,600
Total Importation, ..	28.330,000	26,291,000	28,773,000	29,004,000	27,734,000	26.164,000	23,182.000	223,500	217,900	234,600	220,700	186,100	135,400	134,900
Total Consumption, ..	29,655.000	28,342,000	27,846,000	28,753,000	26,554,000	26.868,000	26,525,000	217,500	218,900	235,800	214,000	179,300	143,500	153,300

	Of Oak Staves, in Loads.						
	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Russia, ...	900	1,000	500	500	600	200	700
Prussia and Germany, ..	19,900	15,500	16,300	17,000	16,000	20,000	17,000
United States, ...	900	1,400	600	1,000	1,000	500	500
Total Foreign Importation, ..	21,700	17,900	17,400	18,500	17,600	20,700	18,200
Canada, ...	900	500	700	400	200	300	500
Total Importation, ..	22,600	18,400	18,100	18,900	17,800	21,000	18,700

East India Teak—The importation of Logs and Planks has been:—

1885.	1886.	1887.
11,558 Loads	18,000 Loads	8,311 Loads

At the beginning of last year we had to call attention to the very unsatisfactory state of the trade for this article, and to the great fall that had taken place in its value. The price was so low that we predicted a very slight increase in the demand would have a considerable effect on the market. That increase came, but not until late in the autumn, when it rapidly influenced prices upwards to the extent of some 20 to 25 per cent. Even with this large advance it is doubtful whether shipping teak is a profitable business, and if we look back some two or three years we find that prices were then some 30 to 40 per cent. higher than at the present time. It may fairly be reckoned that the improvement taking place in the ship-building trade will continue through the present year, and a good and profitable market depends, therefore, only on moderation in the shipments.

The consumption has been 12,200 Loads against 11,100 in 1886, and 10,900 in 1885.

IV. Notes, Queries and Extracts.

FOREST PRESERVATION.

Mr. H. G. Turner, Agent to the Governor in Vizagapatam, in his remarks on the water-supply of the Vizagapatam district, in his report on the administration of the agency tracts during the year 1886-87, writes:—It is a remarkable fact that there is so much misapprehension on the subject of the rise of rivers. Over and again it is stated that brooks rise on the sides of the hills. This was, and possibly still is, one of the many dogmas of the Forest Department, who perpetually implore Government and harangue the public on the folly of cutting down trees on the side of hills because the water-supply of the country is thereby imperilled Now the sources of rivers are not to be found on the sides of hills. Springs do not gush out of the hill-side, like in the picture in the Family Bible which shows a fountain of water springing forth from the rock at the touch of Moses' rod. There is not in the hot weather a single spring of useful dimensions, issuing from any hill-side, in Southern India. Nor is there a congeries of such springs whose united flow forms the head of any river south of the snow-fed rivers of the Himalayas. The sources of all rivers in Southern India are on plateau and in long sloping valleys and swamps; and river water is the gradual off-flow of the rainfall of the country If all the plateau and all the valleys in Southern India were tilted up at an angle of 45 degrees, there would not be a single perennial river in the Madras Presidency. To imagine that rivers rise on the sides of hills is equivalent to a declaration that the sloping roof of a house forms an admirable reservoir. The truth is that a hill-side covered or uncovered with forest is about the worst receptacle for the retention of water that can be imagined. If the forest be cut down and the earth turned up for cultivation, water may penetrate, and doubtless does reappear in the form of springs further down. But all this source of supply is exhausted long before the hot weather sets in, and perhaps in February, certainly in March, miles and miles of forest may be traversed without seeing a trickle issuing from the hill-side. This statement is sure to be contested, but I am prepared to illustrate the truth of my assertion by reference to the head waters of the Saveri, Sileru, Cauvery and Periar, with all of which I have some actual acquaintance. I may say that years ago when I ventured on these views in the presence of Dr. Brandis, he was so struck with their importance, that he proposed to form a committee to test their truth. Nothing was done, however, and people still go on repeating the same old saws, about springs gushing out of hill-sides and of the necessity of preserving the jungle in order to protect water-supply. From that time to this I have never failed to take note of these phenomena, when I have been in the jungle, and everything I have seen confirms me in the accuracy of the observation. I mention this matter here for two reasons: one is that I impress my views on every forest officer I come across, and I trust that I am gradually disseminating a propaganda of disbelief in the older tenets of that department; and secondly, because I want to prevent this reason of protecting water-supply from being brought forward to justify restriction in the matter of the hillman's hill-side cultivation.

Above we reproduce some remarks by Mr. H. G. Turner, Agent to the Governor in Vizagapatam, on the water-supply of that district. It is possible that the printed statement may do less than justice to the report. It is also possible that the report may do less than justice to Mr. Turner's opinions. But taking the statements as they stand, it appears that the Forest Department is charged with the entertainment of certain peculiar views regarding the sites of springs and the *consequent* necessity of preserving hill-side forests. Hence we may profitably briefly indicate the *rôle* of a forest department.

A forest is a collection of trees, but it is something more. In an old forest we have overhead a leafy canopy. Underfoot we have various vegetable growths. This undergrowth is to the earth what the skin is to the human body. The trees rise from this skin like hairs from the body. The skin is composed of shrubs, mosses and grasses. Under this growth is a rich mould which represents the accumulation of centuries. We could sweep it away in a week. No skill could reproduce it in fifty years.

When we lay a seed in suitable soil by-and-bye there comes up a plant. When this plant has put forth leaves and has grown to its full size, from where has it obtained the material for its growth? Is it that the roots suck nourishment from the soil and send up all necessary material in the form of sap? By no means. A large proportion of the new material comes out of the skies. From the air is obtained a quantity of water and a quantity of carbon dioxide. This latter is the gas frequently called carbonic acid. The carbon dioxide is decomposed and the carbon is built up in the tissue of the plant. Liquid water is, so to say, solidified and forms another portion of the tissue.

After a time this plant dies and even while it was living its leaves may continually have died and fallen to the ground. When the plant is wholly dead its past history, so to say, lies around its former home. We are here supposing that the relics are not scattered by wind or by other agencies. The soil now may have more collectively in it and upon it than it had before the plant was sown there. Among these relics we may sow another seed. This in time will give a plant which does indeed to some extent find food in that mould of relics. But also it lays the air under contribution, and is fed by the rain that falls there, or the vapour that comes with the air. When this second plant has wholly died, its relics are added to that portion of the former relics which was not by the second plant absorbed and built afresh into tissue. After many generations of plants have lived and died on that spot of ground, it holds

the tribute received from cubic miles of air through long spaces of time. Such is the history of the soil over which we tread as we wander through an ancient forest. There is old age in the massive trunks, but there is old age likewise in the soil that sustains them.

In similar way, on a coral island in the Pacific there is at first a tiny accidental growth of vegetation. By-and-bye this is multiplied, till we find a fertile island fit for the abode of man. Thus also in the desert of Sahara let us bring water to the surface by means of an artesian well. By-and-bye we have grasses and a row of date palms. These date trees are not transmuted sand, they came from the winds of heaven.

Let us suppose ourselves to do what savages or thoughtless pioneers have done, in many lands—let us visit an old forest and cut its patriarchs down. Now let a heavy rain descend on that mould of ages. It is carried down to rivers or scattered far and wide over lower lands. That mould was potential wealth—that wealth exists no longer.

On the other hand, let rain equally sudden and equally violent descend on an old forest. Much will have fallen before the ground below has become appreciably wet. After the leaves have received as much as they can hold, the soil will begin to get droppings. The water thus gently falling from the height of the lowest leaves will not disturb the arrangement of the mould. This mould will act like a dry sponge absorbing and accumulating in its interstices a great mass of water. This mould in turn holds up the water so that for a time nothing finds its way to the lower lying strata. Frequently all the water that has fallen will be lodged and retained in the mould. There it can remain a considerable time, as the evaporation will be slight. Meanwhile, the grasses, shrubs and the great trees will be feeding on this water. Thus the mould acts as a treasure house or reservoir. But if such a heavy shower were to fall on open land most of the rain may run off before the vegetation has had time to make proper use of it, and, in so running off, it is not only useless, but injurious, as it carries good soil along with it. Especially is this likely to happen if the open land is on a hill-side.

In a country like India we may have months of dry weather, and then the rain comes down as if all "the waters that are above the firmament" had decided to stop there no longer. If these waters, which are above the firmament, could be arranged in the manner of a shower-bath—ourselves to pull the string when so it pleased us—then forests anywhere, and especially in countries like India, would lose one of their recommendations. Here we have

only been thinking of forests as modifiers, distributors or reservoirs of moisture. In some of the States of North America the early English settlers cleared off the forests with such thoughtlessness, that now for the manifold wants of their thriving communities they have to import timber all the way from Canada. Probably these are some of the truths that the Forest Department are preaching in Vizagapatam.

Let us now consider the question of the site of a spring. At one of the highest points of the Brocken, which is the topmost peak in the Hartz Mountains, there gushes out a spring called the "Sorcerer's Spring." It is so called because its appearance there suggests some sort of magic. The wonder is where the water comes from to supply its unceasing flow. The explanation is that the mountain is crowned by a plateau. The highest point of this plateau is about twenty feet above the spring. When the extent of this plateau is considered and the quantity of rain that falls on it is calculated, it is found that the rainfall is more than sufficient to supply the outflow of the spring.

This spring is exceptional in its position, but it is mentioned here as a caution against the dogma that springs *never* rise out of hill-sides.

Let us for the general case consider rain falling over a large extent of mainly open country. All that the vegetation and topmost soil does not at once absorb sinks to lower strata. As long as these are easily permeable the water continues under the action of gravity to work towards the centre of the earth. At last the water reaches some water-tight stratum, and then its course must change. This stratum will not be a perfectly level plane, but it will have crumples or folds—though these may be only slight—and will in some direction slope downwards. Along this downward slope—which again may be slight—the water will run. As it runs it will chiefly collect in the folds or channels, and these channels will run into each other. Thus we have a subterranean system of streams, all running it may be finally into one main stream. If this impervious stratum somewhere strikes the surface of the earth, then at that place—called the outcrop of the stratum—the water will gush forth and we give it the name of a spring.

The water in its course to the spring may have ups and downs. All that is necessary is that the spring itself shall be at a lower level than some other parts of that water-tight or impervious stratum. Whether this outcrop of the stratum happens on a hill-side or happens in a valley between two hills is—so to say—an accident.

Let us for a moment imagine that the spring rises out of a hill-side and let there be a small forest round the spring. Then the outflow of that spring is only slightly influenced in any way by that forest, for the spring may drain a thousand square miles of the earth's surface while the forest may be less than ten square miles in extent. If a forest department took to protecting that forest it would not be with the chief object of preserving undiminished the outflow of that spring.

As another case, let us suppose a couple of long hill ranges with a valley or system of valleys between them. Let us imagine that the water-tight stratum crosses these hills passing under the valleys —not striking anywhere in the neighbourhood the surface of the earth. Then the rain that falls and sinks into the ground on those hill-sides which face the system of valleys will tend to run into the valleys. The water thus forms a curved sheet following the indentations of the water-tight stratum. In the valleys the upward pressure of this water thus resting on the impervious stratum becomes great, as it has what engineers call a head of water. Suppose that somewhere in one of the valleys the ground above the water-tight stratum is easily penetrable by the water. Then the water will well up there, and though it may begin with a small opening, it will gradually enlarge it by the mere mechanical action of the water. In this case we have the spring site in a valley. The lower the site where the water finds its way back to the earth's surface the more abundant the flow is likely to be, because the extent of earth surface thus drained is likely to be larger. Such a spring is also likely to be more constant in its flow, for though there may be dry weather over one part of the thus drained earth surface, heavy rain may be falling elsewhere, and so keeping up the average.

Lastly, suppose that in the valleys between these hill ranges there is no one small spot of earth below which the ground over the water-tight stratum offers an exceptional facility to the upflow of water. But let there be a somewhat considerable extent below which the soil or the rocks are all equally and moderately pervious. Then the water will tend to escape upwards through this extent of ground, and we have perhaps a lake formed. If the outflow of water is less considerable, or the evaporation is great, we may only have a marsh or swamp. In this latter case there is no reason why the ground should be nearly level.

If, however, the forest is comparable in extent with the country drained by the spring, then the value of the forest in sustaining and equalizing the flow of the spring has been proved beyond all question. Especially is this the case when the land is on a slope.

As regards the statement that a "hill-side is about the worst receptacle for the retention of water that can be imagined," it may be sufficient to mention that on the peaty mountain slopes of Ireland and Scotland there are lodged at the present moment some millions of tons of water.—*Indian Engineering.*

In the Himalayan Country.—The country of the outer Himalaya—the tracts which form the base of the vast triangle which has the isle of Ceylon at its apex—is the most charming for climate and the most surpassing for grandeur and beauty of scenery of all the districts, countries, and places of India. The writer is familiar with but one part of this long line of territory, and of that part he takes up his pen to give some account; but he believes that he may say with correctness that there is vast similarity everywhere along the great wooded base which looks down on the plains of Hindustan, in front of the eternal snows, from the Punjab territories, far to the left, to Darjeeling and parts adjacent and beyond, away to the right. You have the same sanatoria for British soldiers; hill stations for the European community generally, which vary only as one English town differs from its neighbour; and nestling in nooks all over the hill-sides, you have the same sort of native inhabitants, semi-Hindustani or Indian and semi-Mongolian in national type.

Of late years, the most notable movement in these mountain districts has been the establishment of the Forest Department by the Government of India, which has, by the hands of this department, assumed formal possession of all the great forests; has set about taking care of them; and, further, of multiplying and increasing both the area and the best natural products of these enormous and majestic wildernesses. Noble are the mightly hill-sides, indeed; and in the verdure with which they are clad may be counted many varieties of pine and classes of kindred genus. The deodar, which we believe is a cedar, is esteemed the most valuable. In the hill-tracts which face the upper provinces of India, the mountains generally are wooded only on the sides looking backward to the higher ranges, the snowy chain behind; and the slopes which look south, to the sun, are yellow and bare. At points along the line of railway which runs for many a hundred mile from Calcutta in the south-east to far-distant Peshawar, right on the distant verge of empire, one can alight to go to the hill station of his choice or to which duty draws him. Darjeeling, which is now a great place, can be reached from Calcutta direct; and by going

up the line, one can alight for Naini Tal or Mussoorie, for Dalhousie or Simla ; but to get to these places, after leaving the main line, one must undertake a second journey, which varies in length and in difficulty with the station selected. But refreshing it is, when you *do* get there, and you can appreciate then what 'climate' means ; and you are apt to go about enjoying each mouthful of the fresh air, with hands extended, as if to grasp and weigh and feel the delightful commodity.

The climate would be considered good and bracing for any country in the world ; and the Forest officers are quite appreciative of the great advantage that in this respect they enjoy : and they cling to the hills, although, as compared with some other departments, the Forest is not well paid ; while the life is often one of complete isolation. The Forest officials have rather a difficult course to steer in their dealings in the way of duty with the native communities of the hill-side and the glen. The villages are legion ; they are scattered about everywhere, and they have, the writer infers, many claims, coming down probably from unknown antiquity, which are apt to clash with the great claim of imperial lordship. But the department appears to be very wisely guided ; and the officials are trained men, not rarely of high scientific attainment ; learned in all native languages, and in social position equal of course to any. Jolly little cribs some of the forest huts are, and in much, very un-Indian like ; but covered with trellis-work and creepers, half hut, half bungalow, they carry one away from things Indian, especially when the sun is sinking low behind the great mountain walls, and the air is getting chilly, chilly. Very pleasant then to turn inside, where the little room is ruddy with the light of the roaring fire. On the sward near the house you may see, too, English daisies; but *they* do not come naturally ; for if they exist, they are due to the horticultural tastes of the officer of the circle. The villages are low in the interlying valleys, but sometimes on the slopes of the hill. Some look like a collection of Swiss cottages, two-storied and roofed with slate ; and Swiss or not, certainly unlike anything in the lower regions, 'the plains,' from which we have just ascended.

In one large village which the writer visited, he was struck with the fine appearance of the female community. They looked far finer beings than the men, and were full in form, with remarkably large and expressive black eyes ; and, generally, buxom of figure and expressive of face ; while the men appeared very ordinary, thin, and shabby creatures.

Another charm of 'the interior'—as the regions lying away

from the hill stations are called—is the pheasants. Here you get the noble birds amid the noble forests. There are several varieties, but the most prized is the *moonal*, which is got at the highest elevation, and whose coat is of a beautiful azure. You may be 'worse off,' indeed, than to be wending your way home to the hut carrying a heavy pheasant, which you have just bagged on the soft grassy brow of some great declivity; turning, now and again, to look at the sunset light still welling up from the sable deeps of the opposite ranges; and then feeling the frozen ground of the forest path crunching beneath your feet; while your retriever comes pattering after you.

There is other game than pheasants on these alps, however, very different; and the pursuit more arduous. Bears abound, and tigers are at times very troublesome. The bear, although not fond of showing fight, can maul most frightfully with his claws, which resemble those of a garden rake, and his favourite *coup* is to scalp. Mr. P——, a Forest officer, lost his life by a fall from a precipice in an affair with a bear; and as to tigers, our host at Deoban, Mr. S——, was the lucky man who, a few years ago, killed a man-eater, for whose destruction the whole station of Chakrata turned out, soldiers, civilians, and all, a comprehensive line; and the animal fell to the rifle of Mr. S——. In a jar of spirits in the bungalow some human remains are shown that were found in the stomach. Close to Deoban, Mr. G——, of the Forests also, a noted sportsman and shot, while walking along, heard some noise behind him, and discovered that he was being followed by a tiger. He signalled to his servant to hand him his rifle; and returning towards the striped animal, he 'let him have' a bullet in the head, and 'bagged' him; the shot being as accurately placed between the eyes as if done by a pair of compasses!*

In the winter-time, the writer has seen the icicles hanging plentifully, long and solid, from the eaves of the Deoban bungalow, the snow lying deep everywhere, and the vast woods shrouded, silent, in the soft ghostly garniture. This spot is some 9,000 feet above the sea; and after a stormy night, the writer has seen the clouds lying like a great calm sea *below* one, with here and there the tops of hills for islands. The *coup d'œil* was superb and enchanting: the millions of surrounding trees mantled in saintly snow: below one's feet, the floor of cloud, 'vast—motionless'; far away, the white bulwark of the eternal snows; and over all, in exquisite contrast, the pale blue of the sky, with the sun as yet

* This did not happen near Deoban but in the Bhagaratti valley.—[Ed.]

unrisen. Such a scene is not often beheld, and forms a diamond locket for Memory to keep with her.

In the summer, which is always pleasant in these altitudes, wild strawberries patch the sides of the hills with red. Eaten 'one by one,' these have not much flavour; but munched by the handful, they do give out some characteristic relish, albeit a faint one; and they make very nice jam. Apricots are grown in the native villages, and these, too, are better as jam than eaten from the tree. Rasps and blackberries can also be gathered; and the writer remembers gratefully the confections made by a lady-friend resident at the neighbouring military hill station; and all made from native fruit, supplemented by perhaps English strawberries. In the military station, in cantonments, you might well forget India, for everything looks so English. Neat brick buildings of all sizes, with slated roofs; brisk, stalwart redcoats; neat young English women passing by; and in the gardens below the railing-lined walk, little fair-haired English boys and girls laughing and playing. And the fresh, glorious air, how it comes in billows up the wide steep ravines, with the diminished trees and villages far away down! And looking level, you feel the sensation of being up in a balloon! Here the newly arrived regiments are sent when just out from England, to be 'set up' by a year's residence, ere going to their long spell of duty in the hot plains beneath. And the English look, mostly, as if the place did them good; and you may see as healthy visages and as rosy cheeks here as you could wish.

To revert to the strawberries. The writer recalls a time when he went strawberrying with the help of all his baggage coolies, to gather for jam-making; and how a favourite dog, Sancho, a water-spaniel, was as keen after the berries as any, and would hunt for them in company of his master, and with roguish delight would seek to be first at a good one, pouncing upon it with his paw; and with waving tail, and the white of his knowing eye showing, refusing to let go! A hill pony that had been for years in the plains enjoyed himself, too, on another occasion; and when he came to a stretch of snow lying by the roadside, would delight to go among it and to toss at it with his nose as he trotted through it. It is requisite in these parts to have horses that are accustomed to the hills, for animals coming up freshly are apt to get terribly puffed and blown with but little exertion. Ponies are preferable to horses, but the latter are extensively used. Not far from the cantonments of which we are writing is the spot where, in the year 1871, Captain Lillingston of the Forest department lost his life by his horse's foot slipping. He fell, not over a sheer precipice, but

down a long grassy bank ; and was found dead at or near the foot of it ; and the horse too. A simple stone with an inscription and I.H.S. marks the place on the path by the lone hill-side.

One branch of the work of the Forest department is the cutting of sleepers for railway purposes, and the floating of them down the streams that wind towards the plains at the bottom of the ravines in the mountains. The deodar cedar is the best, we believe, for sleepers. This is a most important part of the department's operations. Another is to supply the cantonments with firewood ; and lastly, it devolves upon them to offer a great deal of general hospitality, which they obligingly do, and at no small sacrifice, for many are the calls upon them, both upon their time and their cellar and larder, by friends well known and by the passing stranger.

It is a grand mountain country. The scenery is of great beauty and grandeur ; often more bare and bold than beautiful ; yet in the aspects facing the north, where the trees abound everywhere, one finds scenes of singular nobility ; and on most days you can get a view of the higher monarchs, the eternal snows. These, however, are distant, and not, therefore, so imposing as imagination will figure them, and the snow appears at times as of a metallic tinge. But it is grand, nevertheless ; and the air cold, bracing, glorious. Lovely are the pinewoods when the late afternoon sun is lingering among them ; and the high bank where the wild thyme grows, on the misty morning when the sun is slowly climbing up from the east, there is health and pleasure and poetry there too ; as there is when the aromatic scents from the forest side steal over one like soft and subtle music.—*Chambers's Journal.*

THE FORESTRY OF WEST AFRICA.*—This, as its title indicates, is intended to form a hand-book to the economic plant-products of Western Africa. Although the author is Governor of a British colony in this region, his remarks are by no means confined to British possessions, but are intended to include all that is at present known of economic interest connected with the plants of Western Tropical Africa.

Following Prof. Oliver, the author deems it expedient to divide Western Tropical Africa into two principal geographical regions. The first, called Upper Guinea, includes the western coast region

* Sketch of the Forestry of West Africa, with particular Reference to its Principal Commercial Products. By Alfred Moloney, C.M.G., of the Government of the Colony of Lagos. (London : Sampson Low, Marston, Searle, and Rivington, 1887).

from the River Senegal on the north to Cape Lopez immediately south of the equator; the interior drained by rivers intermediate between these limits, and the small islands of the Gulf, Fernando Po, Prince's Island, St. Thomas, and Annabon. The second region, called Lower Guinea, includes West Tropical Africa from Cape Lopez southward to the Tropic of Capricorn, including Congo, Angola, Benguela, and Mossamedes. Within the limits here indicated we have British possessions represented by "colonies" and "protected territories," and we have numerous possessions claimed by the French, Portuguese, Spanish, and German Governments, some of which have only lately been acquired in the European scramble for African territory. It is only right to mention that the term "possessions," as here applied, is somewhat a misnomer. There is little practically possessed, even by ourselves, except a slender coast-line: the interior is described as having no "territorial definiteness," and it is politically, no less than scientifically and commercially, unexplored. Capt. Moloney has wisely not attempted to treat separately of the economic products of these possessions. He has taken their present economic botanical productions in order of export value, and we find that these consist chiefly of palm oil, ground nuts, india-rubber, coffee, gum, dye-woods, cacao, cotton, fibres, and timbers. Palm oil, the produce of *Elæis guineensis*, a plant which covers immense tracts of country in Western Africa, is imported to this country to the value of nearly a million and a quarter annually. The yellow palm oil is obtained from the outside fleshy portion (sarcocarp) of the nut, while a white solid oil is obtained from the kernel. India-rubber is another West African product obtained chiefly from climbing vines belonging to the genus *Landolphia*. The author was one of the first to draw attention to the value of *Landolphia owariensis* as a rubber-plant, and it must be gratifying to him to find that the exports of "white African rubber," as the produce is called, have during the last four years risen from almost nothing to a value of nearly £36,000. What is know as "Yoruba" indigo, derived from a large tree, *Lonchocarpus cyanescens*, has evidently a commercial value, but at present it is used to mix with butter or "shea" to make the negroes' hair a fashionable gray!

Numerous West African plants are cited as yielding either gum tragacanth, copal, frankincense, gum-arabic, bdellium, or resin; what is called "ogea" gum, derived from an unknown tree, *Daniellia* sp., is used powdered on the body and as a perfume by women. The true frankincense-tree of Sierra Leone is *Daniellia thurifera*. Camwood, used largely as a dye, is derived from *Baphia*

nitida; but although barwood is generally said to be derived from the same source, it fetches only one-sixth the price of the former. The medicinal properties possessed by numerous West African plants is a subject full of interest.

Various species of *Strophanthus*, the active principle of which was formerly used for poisoning arrows, and is known to be of incalculable benefit in cardiac diseases, and the merits of the "miraculous berry" (*Sideroxylon dulcificum*) of the Akkrah and Adampe districts, which is credited with rendering the most sour and acid substances "intensely sweet," and of the "oro" plant of Sierra Leone, said to act as an irritant poison cumulative in its effects (which has been ascertained at Kew to be a species of *Euphorbia*), are among the numerous subjects requiring further investigation.

A most cursory glance at this book cannot fail to suggest the wonderful wealth both of botanical and industrial problems which are yet unsolved in connexion with West Tropical Africa. The "Flora of Tropical Africa," by Prof. Oliver, of which three volumes are published (the last in 1877), has made a beginning in the work of elucidating some of these problems; but in recent times few men have systematically pursued West African botany, and the entire absence of a resident botanist or of a properly-equipped botanical establishment in any of our West African colonies has left the plants of a most important region to be known only by the intermittent collections of travellers who have either perished there before their mission has been completed, or have hastened home to avoid the effects of the deadly climate.

Nearly 200 pages of Capt. Moloney's book are taken up with condensed notes and references to the economic plants of Western Africa arranged in natural orders according to the "Genera Plantarum" of Bentham and Hooker. To many people both in West Africa and at home these notes, brought together by the assistance of an officer connected with the Kew Museums, will prove of great value. In the appendices are given a copy of the instructions for collecting plants, seeds, and useful plant-products issued by the Royal Gardens, Kew; an ornithology of the Gambia, by Capt. Shelley; a list of Coleoptera and of diurnal Lepidoptera of the Gambia, by the same writer; and a list of reptiles, batrachians, and fishes collected at the Gambia by Capt. Moloney in 1884-85.

The book is well got up and clearly printed, but it has the unpardonable defect of being published without a good alphabetical index. This greatly detracts from its value as a book of reference.

It, however, is the chief fault we have to find with a work full of interesting matter for the first time brought together, and evidently prepared with great care.—D. M.—*Nature.*

THE ANNUAL FLOODS IN THE PUNJAB.—The 'Pioneer' has reviewed our February paper from "Indian Engineering" on the effects of irrigation on the recent excessive falls of rain in the Punjab, and as we thoroughly agree with the conclusions arrived at, we republish the articles for the benefit of our readers.

"The floods which have several times within the last three or four years breached the North-Western Railway in the neighbourhood of Umballa, thereby cutting off Simla for a time from postal communication with the outer world, have been generally attributed to the reckless denudation of the lower hill ranges between Simla and the plains. This view has of course been maintained, and the proper remedy pointed out and insisted on again and again by professional foresters; yet in a spirit of fairness, which cannot be too highly commended, the 'Indian Forester' for this month quotes from a professional engineering paper an article by Mr. J. E. Hinton, C.E., which maintains that the 'true cause' of these floods is to be found in the newly irrigated lands of the Sirsa district watered by the Sirhind Canal. The editor of the 'Forester' makes no comment on Mr. Hinton's article, probably thinking that his statements and the figures advanced in their support carry to professional readers their own refutation. Briefly stated Mr. Hinton's calculation is this: taking 1,000 square miles in the neighbourhood of Sirsa, of which about 1-400th part is under daily irrigation in the hot season just before the rains, and assuming that the evaporation from this is one-fifth of an inch daily (about twice the average rate, but probably not too much for June), we get a million cubic feet of water daily added to the over-lying atmosphere, which, when rapid transportation by the hot north-west winds comes to an end, will speedily saturate the over-lying atmosphere, say to the height of a mile. Supposing these 1,000 cubic miles of saturated air to be carried by south-west winds to the outer Himalayan ranges, and to have the temperature there reduced 10 degrees, the result will be a precipitation of 70,000,000 cubic feet of water, or thereabouts—surely sufficient to give rise to a disastrous flood, so it seems when we speak in millions. But if we inquire how much rain this means when measured in the ordinary way, we find that 70,000,000 cubic feet spread over 1,000 square miles of country mean only 0·03 inch of rain—barely sufficient to lay the dust!"

"The actual quantities of water involved in a downpour giving rise to a big flood are so enormous, that the evaporation from all the irrigated

land in India is a negligible quantity in any investigation into their origin. Thus on two occasions last year the rainfall over the eastern half of Dehra Dún, the Siwaliks and the Nahan hills to the west, exceeded 10 inches in 24 hours—once over a great part of the region, which is much more than 1,000 square miles in area, it was nearer 20 than 10 inches. But 10 inches of rain over 1,000 square miles is 23,233,000,000 cubic feet—a quantity incomparably greater than any result of local evaporation, and capable of producing most disastrous floods if allowed to run off directly into the drainage channels. On the Punjab side of the Jumna such a free course is provided by the denudation of the lower hills. The railway, therefore, gets breached almost as regularly as the rainy season comes round, and in some districts, like Hoshiarpur, the fertile lands of the plain are being smothered under the sands brought down from the poorly consolidated tertiary rocks of the outer hills. On the Saháranpur side of the river we do not hear of such floods, though the rainfall on the Mussoorie Hills, Dehra Dún and the Siwaliks is usually much heavier than to the westward, simply because the soft sandstones of the Siwaliks are carefully protected from denudation by a belt of close forest. Heavy downpours over this region in the month of August have been unusally frequent, it is true, since the opening of the Sirhind Canal; but *post hoc* is not always *propter hoc*, and of the cause of this frequency nothing whatever is known. Every season has its own peculiarities, and each year the heaviest rain has a tendency to recur in particular localities. Some years the region of heaviest precipitation is in North Bengal or Tirhoot, at other times it is Rohilkhand, and this year it happened to be the Upper Doáb and Dehra Dún. But when the heaviest rain falls in the normally moister regions to the eastward (where there are no canals), much larger amounts are not uncommonly recorded, for example over 36 inches at Purneah one day in 1879, and over 34 at two places in Rohilkhand in 1880."—*Pioneer.*

Reclamation of Usar Lands in Berar.—We extract the following from the Annual Report of the Agricultural Department, Bengal, for the year 1886-87 :—

"Having noticed in the 'Indian Agriculturist' that Mr. Maries, Superintendent of Gardens of the Maharajah of Durbhunga, had succeeded in reclaiming lands impregnated with saline matter by planting certain trees upon them, a letter was addressed to him, asking for further information on the subject. In reply, Mr. Maries wrote as follows :—

"'When I came to Durbhunga six years ago, I was much troubled to know what to do with certain patches of saline soils of the worst description. One was the site of an old saltpetre factory where even weeds would not grow. I had this soil dug deep (2 feet) and planted thick

(3′ × 3′) with *Inga Saman* (rain trees), *Albizzia procera*, *Albizzia Lebbek*, *Cassia florida*, *Millingtonia hortensis*, *sissú*, *nim*, *&c.* The best were the two first named. They were sown in pans, transplanted when the second leaves developed into single pots, and grown on till about 3 feet high in pots. The salt ground was prepared as above, and the trees planted early in the rains. The ground in three years was completely filled with roots, and to all appearance the salt gone. The trees were thinned out last year only leaving the best, and the ground is very good now.

"'In another place near my house, where the ground was covered with white salts quite one inch thick, and where nothing would grow, I had holes dug 4′ × 4′, and new earth filled in, and large trees 12 months old transplanted with wood poles, I gave the measurements of two on the worst ground to prove how they have grown—*Albizzia* 5 years old, height 40 feet, girth of trunk 4 feet from ground 3 feet 10 inches. A rain tree same age, girth 1 foot 10 inches, height 20 feet, a spreading tree. The ground now is covered with *dúb* grass, and I have some splendid plantains growing there.

"'The trees I think should be thoroughly established in pots before planting, and this should be done in favourable weather just at the commencement of the rains.

"'The *Inga Saman* produces such an enormous quantity of surface feeding roots, and these yearly decay, leaving a rich deposit of vegetable matter in the ground, and making the soil open, and I have no doubt the trees take up the salts too, that in a few years the nature of the soil is completely changed. The trees should be planted as thickly as possible.

"'The timber is first rate for firewood, and the trees bear lopping well. I should think it would be an excellent tree for swampy feverish places in Bengal or elsewhere, being such an enormous water-absorber; it is as valuable as the willow or eucalyptus, the willow being used by the Chinese as a preventative for fever, and always planted round villages in rice districts.

"'*Albizzia* is said to be a valuable timber; it is certainly a very handsome tree. I can give you a supply of seeds, if you care to have them, for distribution and trial in other places.

"'Rain tree seeds can be obtained from Dr. King, Seebpore Botanical Gardens.'"

"Though the question of reclamation of lands impregnated with saline matter is not of such importance in these as in other Provinces, yet it is by no means an unimportant one in Behar, where considerable areas of saline soil are to be found. Dr. King, who was consulted on the subject, sees no reason to doubt the correctness of Mr. Maries' conclusions, and trees have been supplied by

him for experimental cultivation on saline soil to District Officers who have applied for them.

"A sample of the original soil reclaimed by Mr. Maries is at the same time being analysed with a view to determine how far it really contained saline matter."

TREATMENT OF PLANTS ATTACKED BY WHITE-ANTS.—A correspondent of a northern paper has very recently made known through its means, the fruits of his experience in connection with a certain very simple mode of so treating plants that are attacked by white-ants as to effectually rid them of those dangerous enemies, and this too, when apparently more powerful methods recommended by scientific authority, had proved unsuccessful, both in his own hands and those of other people. We therefore deem it advisable to make known as widely as we can, the precise nature of his successful operations in order that planters and gardeners everywhere, within the limits of this Presidency, who are suffering by the invasion of those insect pests may have a chance of getting rid of them by following his example. This experimentalist, we must add, before going on to describe his special method, had tried the scientifically prescribed remedy of Phenyle, and had "found that its effects only last so long as the scent of the phenyle remains in the ground. For when this gets faint and dies out, the white-ants will attack the plants so treated." The alternative agency employed by the same party, however,—and which he therefore "would recommend to all amateur and other gardeners,—even the "Superintendent of the Government Botanical Gardens,"—is to adopt the following recipe for keeping white-ants from the roots of young trees and plants:—"Get a common mud pot, and half fill it with coal-tar, filling up the remaining space with water, and then leave it in the sun during the rest of the day. In the evening, look at the solution that has been formed, and, if very strong, put a portion of it into an ordinary watering pot of water, and soak the roots of the young trees or bushes you suspect to be attacked by white-ants with it; also take a small quantity of the strong resolution, and daub the bark of them with a rag or brush well wetted with this for a few inches above the soil. This will prevent the white-ants climbing up, as they are so fond of doing, and barking the trees or shrubs." But the like treatment will not suit vegetables of minor kinds. "I tried it the other day" (adds this expert) "on some cabbages that the white-ants attacked after they had been planted out, but it did not succeed. I strongly suspect

the solution was too strong as the young plants were quite burnt up or scorched." The use of coal-tar, *per se*, to protect fruit-bearing *trees* from the attacks of various insect pests is of course an old story known by all Europeans, although it probably has not reached the ears of natives in general; but applying the same protective to ordinary garden vegetable growths would seem to be a novel practice, which is well worthy of a general trial by all gardeners who find their plants of that description invaded by white-ants, or any other crawling insect pests. Coal-tar water will most likely repel any of these which come within scent of it, to say nothing about the effect on them of its *taste;* for everyone who is acquainted with that product of the gas-works must well remember how highly offensive is its *smell*, and how difficult is the operation of cleansing any part of one's person or clothing which has had the ill-luck to get smeared with it accidentally. Before quitting this subject, we may as well draw attention to a kindred matter of considerable importance to coffee-planters at large, since it concerns the doubtful value, to their estates of a certain tree, on which they have hitherto placed much reliance, to wit, the "Atti" (*Ficus racemosa*) regarding which a correspondent has written thus to a Bengal journal:—"It is an open question whether the "Atties" do good by attracting the green bug to themselves, away from the coffee, or harm, by attracting this pest to the estate. I most reluctantly admit my own opinion is, that they must, and cannot but, do harm. For they form great breeding places all over the estate; and although for the time being the bug may keep to them in preference, I fear that it would cease to do so with the disappearance of green leaves and shoots. It is a terrible dilemma that we are in: extermination—if it be possible—cannot be carried out unless every "Atti" tree on the estate, so soon as attacked, is cut down and burnt. And this is the tree that we have so carefully reared and brought up for shade."—*Indian Agriculturist.*

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IMPRESSIONS OF A MONTH IN THE FORESTS OF SOUTH BERAR, WITH SPECIAL REFERENCE TO "LIGHT-GRAZING."

THERE are many interesting, and some even important, questions connected with the Berar State forests, and their capacity for subserving to the various requirements of the Province in timber, fuel, grass, pasture, &c., &c.; and it was my intention to have written, later on, a Note on Berar which, I hoped, would contain information both valuable and original. But, to my great chagrin, I had to leave the Berars at the very commencement, so to say, of my studies. Still, the opportunity was given me for making a minute inspection of the Pathroat, Khorad and Gondnákri reserves in the Wún District; and conditions being, as I have been given to understand, very much the same in the remaining forests of that district, and in South Berar generally, I may be excused, perhaps, if I attach to these impressions of a month's tour in that part of the Province a value which they might not otherwise possess.

It will be remembered that Berar is the cradle, in India, of a form of treatment that is generally referred to as the method of obtaining natural reproduction by a system of regulated, or "light," grazing, an idea that speedily extended itself to other parts of India, causing, at the time, a certain degree of commotion among seriously minded Forest officers, and some anxious forebodings. This new gospel, as understood by the Civil administration, seemed to show that the Forest Department was imposing an unnecessarily heavy burden on the people, in that it not only closed an immense area of natural pasture, and that in a country where pasture was in high demand, but made matters worse by deny-

ing to the forest what was good for it. Personally, I can say that, in Oudh, where I was then serving, the idea found so much favour in high circles that it not only influenced my efforts to exclude cattle, but raised a question as to the expediency of excluding cattle any where. In fine, the principles of "light-grazing," as expounded to the world, or interpreted by it, gave indications of bearing very mischievous results; and so much impressed was I, at the time, with this circumstance, that I wrote an article in the "Indian Forester" on the subject, with the view of discountenancing, if possible, a too general application of a treatment which, whatever its merits might happen to be under the conditions of forestry prevailing in Berar, was manifestly unsuited to the requirements of our forests in other parts of the Empire. In that article, I expressed considerable doubt as to the practical character of the "light-grazing" method of securing natural reproduction, the operation of which appeared to me to be surrounded with difficulties and dangers of a more or less insuperable nature: and I, moreover, endeavoured to show the impolicy, from a forest point of view, of giving further encouragement to cattle-breeding on the confines of our forests—a state of things which is, even now, being carried to exaggerated limits, creating one of the greatest difficulties with which the Forest officer has to contend.

Since then, the Dehra Dun Conference has sat, and it will be familiar to many of us how Colonel van Someren there explained the advantages of "light-grazing," as applied to Berar, and the special conditions which render that treatment beneficial to a section of its forests, namely, those situated in the southern half of the Province. I need, therefore, hardly go over the arguments used by Colonel van Someren on the occasion, which can be seen in the unofficial report of the proceedings. It will be sufficient to observe that he disclaimed all responsibility for the erroneous notions that had got abroad on the subject, conceding, himself, that "light-grazing" was only adapted to certain very special conditions.

I shall now proceed to give my own impressions of "light-grazing," as formed from personal observation of its effects in the Wún forests of South Berar. Before doing so, I must, however, emphasize the hope that it was not my misfortune, in visiting these forests, to stumble on an exceptional state of things—exceptional as regards the District, at least. The District Forest officer himself assured me that I would not find this to be the case. Moreover, in connection with everything that I am about to say in this article,

I must disclaim any desire or intention to reflect unnecessarily on the judgments of other people. Such criticisms as I may find myself compelled to make will, I trust, appear warranted by the importance of the questions at issue to the Department at large. Most of my remarks relate to "light-grazing," directly or indirectly, and, as such, would seem a natural sequence to my previous contribution to the "Indian Forester" on the same subject.

The Pathroat reserve has an area of 4 square miles only, and has been open to continuous "light-grazing" during the monsoon months (July—November) of the past four years. The ground is, in part, level, in part undulating. Very much of the forest is made up of old cultivation, the fields of which remain either blank, or are imperfectly clothed with a vegetation consisting principally of thorns. The remainder of Pathroat comprises a stock of teak-poles, dwarfed, branching, misshapen, diseased, associated with a preponderance of such species as *Terminalia tomentosa*, *Lagerstræmia parviflora*, *Butea frondosa*, *Acacia Catechu*, *Adina cordifolia*, *Ougenia dalbergioides*, *Phyllanthus Emblica*, *Zizyphus*, &c., &c., the vegetation of which is of a still more unprepossessing character.

The whole constitutes an open ruinous class of forest, in which we observe but few traces of recent successful reproduction—that is to say, undoubted seedlings of more than a year's growth—and but small evidence of either present or prospective resources. Almost everywhere, the soil is hard, stony, and dense—a black cotton soil of generally meagre depth over "moorum" (trap rock more or less disintegrated).

In a forest so circumstanced, it is my opinion that cattle ought not to have been admitted by us. The principal obstacle to reproduction here evidently lies in the soil, the physical properties of which have been so changed by long exposure, resulting from generations of fires and grazing in a depleted forest, as to make successful reproduction impossible for many years to come, unless measures be resorted to which will modify the present condition of the soil in a very important manner. It is, I urge, not the grass that has, in the main, been preventive of reproduction, but the soil; and to uncover that soil, and trample upon it, is to make it even more unfruitful than it now is. In support of my contention that the grass has had nothing to do with the almost entire absence of young seedling growth of the valuable species, that has obtained a permanent footing in the soil, I would adduce the fact that "light-grazing" has signally failed to improve the condition of the forest in that respect. Germination appears to be profuse; but the young seedlings die off, if not at the close of

the rains, then very soon afterwards, showing plainly that their superficial and sickly root system can only live so long as the surface soil contains moisture in it. We see exactly the same condition of things in some of our ruined sál forests of the North of India. In my opinion, "light-grazing" has, therefore, proved rather injurious than otherwise to the Pathroat forest. Undoubtedly, the absence of grass has assisted germination; but it has tended to deteriorate still further the soil, and to make permanently successful reproduction more hopeless than before. And the whole of the forests seen by me in Wún partook of the character of Pathroat; namely, open, ruined forest, with a hard, dense surface soil that nature was doing her best to protect, and soften, and improve with the aid of a friendly covering of grass; but opposed in this by man, "light-grazing," and an imperfect fire-protection.

In observing here that "light-grazing" was not, in my opinion, a correct method of treatment, as regards these forests, my meaning is that *any grazing at all* should be injurious in their case. For, I have been unable, in practice, to make any very clear distinction between "light-grazing" and "heavy-grazing," or any other sort of grazing. The point of difference appeared to me to lie in the area grazed over, which would be necessarily smaller where the number of cattle admitted was, itself, smaller. I do not wish to imply that grazing in moderation is impossible; but that, in practice, it is not feasible to have this moderate form of grazing without the more severe form being itself present in equal, if not greater, degree. Whether the number of cattle grazing over a forest be 500, or 10,000, the distinction will, in my opinion, mainly lie in the total area grazed over, and not in the intensity of the grazing, which may, over a limited area, be as severe in the former as in the latter case.

What I observed in the case of the Pathroat forest was that, for a considerable distance off cultivation, the grazing had been excessive,—so much so in some localities as to leave no visible herbage an inch high,—while, beyond this, the grass had been consumed in moderation, or not at all. In Khorad and Gondnákri, where the ground shows an alternation of low steep hills and extensive basins, the appearance of things was not quite the same. There the plateaus and lowlands had alone been grazed over, and, of course, the grazing had been proportionately severe, but always increasing in intensity with the nearness of the villages.

All these conditions are such as could have been anticipated in the circumstances of each case. Given a forest, or a section of a forest, open to pasture for a given period, the herdsman in charge

of a given number of cattle will shape their movements according to a few simple considerations such as the following; and it should be evident, after very little thought, that we have not, and, moreover, cannot possess, the means wherewith to control those movements in harmony with considerations of our order. Assuming that we could afford the necessary establishment, and that the intelligence of our guards was only equalled by their industry and incorruptibility—and both qualities are sorely wanted for the purpose in Berar, where this "light-grazing" takes place in the monsoons; that is to say at a time of year when the superior officers are shut up in their head-quarter stations—the task would be too much for them.

(*a*). The herdsman will avoid scattering his cattle, for fear of tigers and leopards, and with a view to having them always under control. It is in his interest to concentrate them as much as possible. Consequently, the ground grazed over each day will, if not excessively grazed, be at least excessively trampled upon, the result being hardening of the soil, and the destruction, or mutilation, of seed and seedlings.

(*b*). He will not take the herd further from the village than is absolutely necessary to his purpose. Cause and effect are, both, here sufficiently intelligible, and require no explanation.

(*c*). He will avoid hilly and difficult grounds, as also localities removed from water, or comprising bad or indifferent pasture, the consequence being proportionately heavy grazing in tracts oppositely situated.

(*d*). After having grazed in a certain locality, and removed from it, he will, after a variable time (during the monsoons, within a week or two) return to graze over it once more, and in preference to the untouched pastures ahead; for in the meantime, succulent young shoots will have sprung up in the portions of forest first grazed over, which will be as much more relished by the cattle as the closer neighbourhood of home will be appreciated by the herdsman. This is one of the principal obstacles to the introduction, in practice, of a system of "light-grazing," although, as we have seen, by no means the only one. The forest is very unevenly grazed over. The centre may escape grazing altogether, while the tracts bordering on cultivation—that is to say, the localities most generally in want of reproduction, and of pro-

tection to the soil—will be found very much over-grazed; unless, as I found to be the case in parts of Khorad and Gondwákri, the forest border is conterminous with very extensive village grazing lands.

If all these circumstances be considered together, it will be seen how difficult it is, short of an expensive, and indeed impossible, control, to regulate any sort of grazing-scheme in the interest of the forest. Even on the supposition that we could parcel out the forest—and, in practice, we cannot always do so—into small divisions representing, say, a week's pasture, no precaution on our part can prevent even these areas being over-grazed during the period corresponding. The cattle may not, in this case, have the means of returning to grounds already grazed over by them; but nothing in nature will prevent the cattle from congregating in dense masses, according to the manner of cattle. They may be only a week in that particular section of the forest; but they will avoid its bad pastures, eschew its hilly and waterless tracts, and trample over every square yard of such parts as they happen to select in preference.

This is how I understand "light-grazing," as practised in Berar. I may be wrong; but such is the impression left on my mind after a careful study of the conditions prevailing in parts of the Wún District.

I have dwelt on the ruinous condition of these South Berar forests. It is deplorable. Yielding no revenue worthy of the name, hardly susceptible of doing so for a very long time to come, and costing a round sum of money each year, we are forcibly reminded, on looking at them, of a sentinel grown grey at his task of patrolling up and down before some ruined castle. The actual stock is of the most worthless description, and the evidences of improvement, as regards the future, are not hopeful. The fertility has departed from the soil. Nature, in the course of a generation or so, with the aid of its protecting coat of grass and other herbage, would, doubtless, succeed in restoring to this impenetrable surface some of its old properties. But, of our own accord, we have invited the cattle to destroy the work of Nature, completing the ruin of her endeavours by an imperfect fire-protection.

It should be observed here that there is no "close-season" in Berar; that, notwithstanding the natural difficulties to fire-protection comprised in a very dry climate, in savannahs of tall grass, and the presence of numbers of native shikaris, the people are permitted to wander through the reserves at pleasure from year's end to year's end. Evidently, a state of things like this is not compati-

ble with a serious system of fire-protection. Fire-conservancy has, it is true, been very successful—extraordinarily so—in North Berar, in the Melghât regions. But the paucity of population, the circumstance of its being mainly composed of "Kurkus," very friendly to our administration, and local conditions pertaining to the configuration of the ground, render our operations of protection exceptionally easy in that direction.

Broadcast sowing, unassisted by a previous preparation of the soil, has, I believe, been resorted to in all the South Berar forests, and for some years past; but in the forests inspected by me no instance could be found of its having been a success. And it is, I urge, of no use to scatter seed under conditions where it has about as much chance of succeeding as on a gravel walk. Whether sown broadcast by the hand of man, or naturally so by the elements, we cannot expect seed of the useful species to develop properly under the conditions now prevailing in these forests. Nor would the uneducated cultivator himself dream of obtaining any sort of crop out of this soil without, in the first instance, ploughing it up, or altering its constitution in one way or another. And this is, I consider, what we should also do, if we wish to restore these old South Berar forests, of which the soil is, in its present state, totally unsuited to the reproduction of any valuable form of timber. In circumstances such as those before us, it would be foolish to abide the course of Nature: we must meet her half-way.

All the best parts, and, at times, the more considerable parts, of these forests are made up of abandoned cultivation, and there should be no difficulty in the way of opening up these lands with the plough, and so preparing the soil for the reception of seed, which might then be sown broadcast, as hitherto.

All our hope and promise lies in these old fields. Once out of them, we arrive on soil so shallow and stony as to be unsuited to our purpose. Thus, the fine basins of Khorad, affording excellent sites for plantations, alternate with hilly ground, upon the stony surface of which nothing but the useless *Boswelia* can, seemingly, live and thrive. We notice a similar state of things in Gondnákri. This work of breaking up the soil into lines of, say, 15 feet in width, separated by equal expanses of waste, added to the cost of collecting and sowing seed of such species as teak, *Terminalia tomentosa*, *Bassia latifolia*, *Ougenia dalbergioides*, *Lagerstræmia parviflora*, *Pterocarpus Marsupium*, and a few other useful species locally found, would not involve an outlay of more than Re. 1 per acre. This is not excessive, and experimental operations of the kind should, I think, be undertaken over large areas, and in a

serious spirit. I consider that, throughout India, we are too much disposed, when once fires have been kept out of the forests, to fold our arms, and, in the case of ruined forests like those under discussion, to wait patiently for Nature to assert herself, careless, or oblivious, of the fact that soil deterioration is a much more common, and a much more serious, evil with us than in the moist climate of Europe. In the former case, the natural restoration of the forest is effected more slowly and with much greater difficulty. And yet it is wonderful by what simple means, by what readily available contrivances, the necessary properties can, occasionally, be restored to the soil, and a young growth produced, which would, otherwise, not be forthcoming, perhaps, for a generation or more. In this way, I have often remarked the vigorous propagation of sál in the tracks made by a log, whilst being dragged. What a lot of useful work could we not cheaply execute by improving on this very simple process!! But now-a-days we recoil from any operation that may cost money. Our whole energy is devoted to showing a surplus greater than that of the year before: expenditure is sought to be reduced to its lowest limit. If cultural operations are attempted, then they are of a kind which involve no outlay, and yet look well in an annual report. When several square miles of waste have been sown—actual area impossible to determine—broadcast with seed, the Department is supposed to have done its duty. If we have any misgivings, a look at the surplus tends to dispel them.

It was explained to me, and the allegation supported by reference to the miserable vegetation around, even in the valleys, that the soil is too shallow, in these South Berar forests, to admit of good timber being produced. But I think I convinced my audience—pointing to the fairly good dimensions of the mohwa and pipal trees that were to be seen at intervals among the generally dwarfed vegetation—that the present condition of the stock was due to the unrespecting hand of man in all that did not touch his greed or his fears, and had no foundation in the quality of the soil, which was sufficiently good and deep, over extensive areas, to produce, if not valuable, at least useful forms of timber.

The absence of good, even decent, timber all over South Berar, the strides being made by cultivation, and the rapid exhaustion of the so-called "grazing-lands" as sources of timber-yield, make it imperative that such areas as we have been enabled to set aside for the production of timber should also be made to contain timber, and this without loss of time. The conditions of Berar administration, under which the surplus revenue is made over to the Nizám,

and an income realized from the forests only half as large as that which might be legitimately secured, give facilities, such as other parts of the Empire do not possess, for improving, on an extensive scale, the forest estates of the Province.

As a postulate to what has gone before, it might be added that the contents of the existing reserves being of such an unsatisfactory character, both in regard to the quantity and the quality of the timber, no opportunity should be missed for increasing their area, which would be considered small under any circumstances.

E. P. D.

THE NILGIRI 'STROBILANTHES.'

THIS large genus of very interesting forest shrubs contains, according to the Flora of British India, 146 fully described Indian species. There is scarcely any part of India in which at least one species may not be found, while in some parts the species are so common as to be specially remarkable. Everyone who has been in Simla and taken an interest in its Flora, must have seen the beautiful blue flowers of *S. alatus*, in the woods of Mahasu, Theog and Nagkanda. Visitors to Darjeeling can hardly have helped noticing, in those years in which they have flowered, the graceful purple corollas of *S. divaricatus*, brightening the banks of the Birch Hill walks, the tangled growth of the bright-blue flowered *S. Wallichii* at Senchal, and the variegated leaves of *S. petiolaris*, on the road to Rungbee. In Assam, the handsome *S. flaccidifolius* is cultivated for the sake of the indigo dye which its leaves afford, while another Assam species, *S. isophyllus*, is a common ornament of the gardens of Calcutta. *S. auriculatus* is a cold-weather flowering species, which may be seen in perfection in the sál forests of Chota Nagpore, and away down into those of Ganjam; while the species which Mr. C. B. Clarke considers the finest of all, *S. scrobiculatus*, adorns the ghâts of the Bombay Presidency, and should be well known to the botanists of Mahabaleshwar. But it is probably in the South of India that the Strobilanthes reach their largest size, and are most conspicuous; and though there are some very fine ones to be found in the Anamalai, Pulney and Travancore hills, it is especially in the Nilgiris that the shrubs are most easily seen in perfection.

The annexed list shows most of the species of the Nilgiris. Most of them the writer has collected himself, but one or two he has received from Mr. M. A. Lawson, the Government Botanist of

the Madras Presidency. The Flora of British India which describes the specimens in the Kew Herbarium collected by Wight, Gardner, Beddome and others, might add two or three species, and there are probably several whose flowers are not yet known. The writer knows two or three species by the leaf only, but has not yet succeeded in finding the flowers.

The 'Strobilanthes' do not all flower regularly every year: some few species do, like *Wightianus* and *Perrottetianus*, but more ordinarily the species flower only after long intervals and then die down. The stems if not burnt, rot away, and the next year the ground underneath is carpeted with a mass of young seedlings which gradually grow till their time of flowering comes again, and then die off in their turn. *S. homotropus* died off in this way on the Sispara ghât in 1884, *S. asper* at Naduvatam, and *S. sexennis* on Doddabetta in 1885, and *S. pulneyensis* on Cairn Hill in 1886. *S. heteromallus* also flowered in 1886 on the Coonoor ghât, and has probably since died. So dense is the thicket of Strobilanthes in the undergrowth of the forests, that under ordinary natural circumstances it is really only at the time of the periodical flowerings that the tree seedlings get a chance of a start. There are usually thousands to be found under the thicket, but until the Strobilanthes dies, or is cut away, they simply remain stunted, waiting till the removal of the cover gives them a chance, and then they usually take advantage of it and come on quickly. It has, consequently, on the Nilgiris been lately found useful to assist in disengaging the seedlings by clearing away the growth of Strobilanthes. In the forests around Ootacamund and Coonoor, where there is a large demand by the poorer classes of natives for small fuel, and where the hard, brightly burning wood of the Strobilanthes is much appreciated, it is possible to clear away the growth of it and not only allow of the young tree seedlings getting a chance of growing, but provide a considerable amount of fuel, ample, at very cheap rates, to cover the whole cost of the work. In the Lamb's Rock forest, 37 acres 'cleaned' in 1886, at a cost of Rs. 222, produced 9,038 head-loads of fuel (about 323 tons), realizing, at one anna each, Rs. 565, equivalent to a net profit of Rs. 9-4-0 per acre. Something like nine-tenths of the material cut consisted of 'Strobilanthes.' The good results of this work were most marked: myriads of seedlings were disengaged, and a few years hence, with the help of a seed cutting or cutting under selection in the cover, what was a few years ago merely a dilapidated shola with cover of old, mostly unsound, trees and underwood of Strobilanthes, will be converted into a fully

stocked pole forest. It may easily be understood that the clearing of Strobilanthes must precede the seed cutting, or the cutting under selection (jardinage). When the cover over-head in a forest is light, the bank of Strobilanthes underneath is often very valuable as assisting to retain the moisture in the soil, prevent fires, and nurse the tree seedlings, and in some cases it is best not to clear away the growth too wholesale, but to disengage seedlings in plots where they are found sufficiently thick and good. An example of a shola in which not only the Strobilanthes were cut, but also the covering trees some years ago, may be seen in the valley at the back of the inspection house at Naduvatam. There, the growth of new Strobilanthes and tree seedlings together is so thick as to be at the disadvantage of the latter; and, did funds admit, the Strobilanthes should now be thinned out.

The most common and best known species is *S. Kunthianus*, which prefers the dry slopes of the eastern side of the hills, where there is little or no tree-forest. In such localities it is chiefly found associated with the Nilgiri gooseberry (*Rhodomyrtus tomentosa*), the bright flowered *Hypericum mysorense*, the yellow raspberry (*Rubus ellipticus*), the barberry (*Berberis aristata*), the shining leaved *Dodonæa viscosa*, the pink-flowered *Sophora glauca*, and the wild date *Phœnix pedunculata*, while the beautiful large white bells of the Nilgiri lily (*Lilium neilgherrense*) may be seen in places lifting their heads through the shrubby growth. But when in flower it is the Strobilanthes which gives its colour to the scenery, and the hills may often be seen coloured of the bright blue colour which has led some persons to attribute to this circumstance the origin of the name of the 'Blue mountains.' *S. Kunthianus* flowers at intervals of some four to six years. It flowered profusely in 1881 and again in 1886, and may be again expected to flower about 1891, though sporadic flowering specimens which have not died may here and there be met with in most years. On the downs to the west of Ootacamund the *S. Kunthianus* is replaced by the much smaller *S. sessilis*, a beautiful plant of a lovely tinge of blue. Almost every year the sholas of Ootacamund become gay in autumn with the blue, lilac or white flowers and the reddish young leaves and bracts of *S. Perrottetianus*, while in some sholas *S. foliosus*, a quite different looking kind, is more common, and grows to a larger size of wood, having often stems of 4 to 6 inches in diameter. The chief species on the higher parts of Doddabetta is *S. sexennis*, which has a powerful and rather unpleasant odour, though when in flower, it shows a beautiful mass of bright blue panicles. It flowered last in 1883, and then died down, leav-

ing its knotty stems to be used as fuel and myriads of seedlings to form a new crop.

In 1886 there flowered in the Cairn hill sholas a species with a curious narrow-necked bell-shaped flower, which has been identified as *S. pulneyensis*, hitherto only known from the Pulney hills. Another common Ootacamund species is the rough looking *S. Wightianus*, which grows indiscriminately on grass land or in shola, and flowers yearly.

About Coonoor, in the Lamb's Rock and Tiger Hill forests, besides *S. foliosus* and *S. Perrottetianus*, a species is found which Col. Beddome says he watched for years without finding flowers. The flowers came in 1886, and the plant seems now to be identifiable with *S. heteromallus*, except that the seeds, instead of being glabrous as described by Mr. Clarke, and as shown in the very few specimens in the Kew Herbarium, show when wetted, a dense mass of shaggy white hairs. This species grows to a very large size on the Coonoor ghât, and does not seem to have been gathered in flower since Dr. Wight collected it in 1850. As Col. Beddome had, during these 36 years, such fine opportunities of watching it, it may be that its period of growth is so long as 36 years, or it may have flowered unnoticed every 12 or every 18.

Some of the most beautiful species are those of the Kundahs, and especially at Sispara, where in 1883 was found the beautiful but sticky *S. amabilis*, with its large panicles of pink bells, and the woolly-leaved *S gossypinus*, which almost alone gregariously covers one large hill side above Sispara. Col. Beddome collected this species in 1870 and the writer in 1883, so that its term may be 13 years, though a specimen of its wood in the Madras collection shows only ten annual rings. The wood is a very hard one, of a pretty brown colour; indeed, the wood of most species, though usually white or grey, is hard and strong, and makes an excellent small fuel. About Naduvatam *S. asper*, a rough looking shrub, flowered gregariously in 1885, and died off, and in 1883 the same happened at Sispara, as already mentioned with *S. homotropus*, a species closely allied to *S. sexennis*. In the same year was found the species which is probably the most beautiful of all, *S. violaceus*, only found in a shola near Bangi Tappal, where it overshadows a fine growth of that splendid fern *Lomaria Patersoni*. The flowers are a deep violet, and so far as is known, it was last gathered by Col. Beddome in 1870.

This short account of the Nilgiri Strobilanthes ought not to close without mention of *S. luridus*, a straggling species of the western forests of Sispara to Naduvatam. It has cone-like spikes

of large dark purple flowers, of which a white variety occasionally occurs, and which grow on the stems on the old wood. It has a near ally in a remarkable species which is only found in the valley at the head of the Noyil river in Coimbatore, *S. bolamputtensis*, a curious species with large serrated orbicular bracts and brown flowers.

The whole genus is one of great interest to the Indian Forester, and to the lover of beautiful flowers. Seeds are often sent home, and the growers wonder why they do not flower; perhaps these remarks may help them to understand the reason.

List of Nilgiri species.

Section 1. 2 stamens. ENDOPOGON.

1. *S. foliosus*, T. And. Very common above 6,000 feet in all the sholas about Ootacamund. Flowers blue, appear annually, leaves bright green.

2. *S. Kunthianus*, T. And. Common and gregarious on dry slopes everywhere above 4,500 feet. Flowers light blue, appearing about every six years; leaves grey beneath, thick.

3. *S. gossypinus*, T. And. Only about Sispara, on the hills between it and the Nadghani precipices at 5 to 6,000 feet. Flowers lilac, appearing about every 10 years; leaves covered with dense yellow wool.

4. *S. cuspidatus*, T. And. Common on the Sigúr ghât at 4 to 6,000 feet and occasionally elsewhere. Flowers blue, probably annual, leaves white silky beneath.

5. *S. consanguineus*, Clarke. Scarce. Northern valleys—Masnigudi—flowers blue.

Section II. 4 stamens. EUSTROBILANTHES.

A. *Bracteate*—

6. *S. barbatus*, Nees. Ochterlony valley and south-east Wynaad, at about 3,000 feet; collected lately by Mr. M. A. Lawson.

7. *S. heteromallus*, T. And. Very common and gregarious on the upper parts of the Coonoor ghât about Benhope—altitude 3 to 4,000 feet. Flowers lilac, appearing about every 10 to 12 years; leaves rough.

8. *S. Wightianus*, Nees. Very common all round Ootacamund, but small. Flowers pale blue to dull lilac, annual; leaves rough.

9. *S. pulneyensis*, Clarke. Sholas on Cairn hill, Ootacamund, 7,000 feet. Flowers blue, appearing about every 8 years.

10. *S. neilgherrensis*, Bedd. Wet forests in south-east Wynaad Flowers blue.

11. *S. Perrottetianus*, Nees. Sholas of the upper plateau, very common at Ootacamund. Flowers light blue, lilac or pink, appearing annually; leaves soft, hairy.

12. *S. Zenkerianus*, T. And. Sholas of Doddabetta and Avalanché at 7 to 8,000 feet; rather like *S. foliosus*. Flowers blue; leaves smooth green.

13. *S. ciliatus*, Nees. Western slopes, Carcoor ghât, about 2 to 3,000 feet (M. A. Lawson). Leaves smooth.

14. *S. tristis*, T. And. Western slopes, Ochterlony valley (M. A. Lawson). Has deflexed pedicels and smooth leaves.

15. *S. Heyneanus*, Nees. A small species of the Wynaad in forest underwood. Flowers blue, in hop-like clusters, leaves rough.

16. *S. micranthus*, Wight. A large species, common in Longwood shola at Kotagiri, where it flowered in 1885. It probably flowers about every 8 to 10 years.

17. *S. papillosus*, T. And. Shrub common in the Kundahs and in a few ravines on Doddabetta at 8,000 feet. Flowers blue, apparently annual; leaves rough, also the bracts.

18. *S. luridus*, Wight. Straggling shrub with large hop-like clusters of flowers on the stem, sholas of western slopes—Sispara to Naduvatam at 4 to 5,000 feet. Flowers dark purple, sometimes white, appearing annually; leaves large.

19. *S. asper*, Wight. Common about Naduvatam at 4 to 5,000 feet; rare elsewhere. Flowers small, blue.

20. *S. sessilis*, Nees. Small species in tufts on the downs. Flowers blue, appearing probably every 4 to 5 years.

B. *Paniculate*—

21. *S. sexennis*, Nees. Large shrub, common on Doddabetta at 8,000 to 8,500 feet. Flowers blue, appearing about every 6 to 7 years, leaves bright green, narrow.

22. *S. homotropus*, Nees. Large shrub very like *S. sexennis*—common in the Kundahs. Flowers blue or white, appearing about every 10 years, leaves bright green.

23. *S. violaceus*, Bedd. A rare shrub. Kundahs near Bangi Tappal. Flowers panicled, violet, appear about every 7 years.

24. *S. amabilis*, Clarke. Shrub, western slopes. Sispara 5 to 6,000 feet. Flowers panicled, pink, appearing about every 10 years, very sticky.

KEW,
4th November, 1887.

J. S. GAMBLE.

THE MINERAL CONCRETION OF THE TEAK TREE.*

At the last meeting of the Nilgiri Natural History Society Mr. Lawson showed a specimen of a whitish mineral substance found in a teak tree growing in the Government Plantation at Nilambúr. This peculiar secretion is not altogether unknown to officers in the Forest Department, and its composition has on more than one occasion been investigated by chemists.

In 1870 the fact of calcareous masses occurring in timber was brought to the notice of the Asiatic Society of Bengal by Mr. R. V. Stoney, who stated (*vide* P. A. S. B., May 1870, p. 135) that many trees in Orissa had pieces of limestone or calcareous tufa in their fissures, but principally asan (*Terminalia tomentosa*, W. and A.), swarm (*Zizyphus rugosa*, Lam.), sissu (*Dalbergia sissu*, Roxb.) and abnus (*Diospyros melanoxylon*, Roxb.)

In 1880 Mr. V. Ball in making a geological survey in the Central Provinces met with this concretion, and thus alludes to it in his "Jungle Life in India." "Some white marks on the cut stumps of an asan tree caught my eye, and these on examination proved to be sections or laminæ of calcareous matter which alternated with the ordinary rings of woody growth. The rocks about were gneisses and schists, and I could discover nothing in the soil to account for the peculiarity. In some cases irregularly shaped pieces 7 inches long by 2 inches thick were met in the trunks at a height of about 6 feet from the ground. By the natives the lime is burnt and used for chewing with *pan*. On examination it was found there was no structure in these masses which would justify a conclusion that they had been formed by insects. Some included portions of decayed wood seemed to be cemented together by the lime."

Major General Morgan, late Deputy Conservator of Forests, Madras, speaks of it in the following terms in his "Forestry of Southern India"—"It is a curious fact that in the Wynaad, though there is no free lime in the soil, yet teak (*Tectona grandis*) and blackwood (*Dalbergia latifolia*), if wounded near the ground contrive to absorb large quantities of lime. It may be seen encrusting the tree on the surface as far as 4 feet in height, from 3 inches to a foot in width, and 2 or 3 inches in thickness. The lime is so hard that it destroys circular saws, and the Carumburs use it for chewing with betel.

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* A paper read at a meeting of the Nilgiri Natural History Society, Ootacamund, November 7th, 1887.

Abel in 1854 thus described it—"The wood of teak, which grows in the South of India and other tropical countries, frequently exhibits cracks and cavities of considerable extent lined with a white crystalline deposit consisting chiefly of hydrocalcic orthophosphate, $C_2 H PO_4$. H_2O, with about 11·4 per cent. ammoniomagnesium phosphate." (Chem. Soc. Qu. J. xv. 91).

This white deposit in the wood of teak has also been examined by Thoms, who found it to consist of monocalcic orthophosphate $Ca H PO_4$. (Landw. Versuchs. St. xxii. 68; xxiii. 413). More recently still Professor Judd has found in teak a specimen of crystalline apatite, a well known mineral containing a large proportion of calcium phosphate.

"The formation of this deposit indicates that the wood itself must contain a considerable quantity of phosphoric acid, and the analysis shows this is really the case as the ash of teak wood is composed as follows:—

C_2O	M_gO	F_2O	K_2O	$N_{a_2}O$	SiO_2	SO_3	P_2O_5	CO_2	Cl
31·35	9·74	0·80	1·47	0 04	24 98	2·22	29·69	0·01	0 01

The percentage of carbon and hydrogen are higher than in most woods, and this together with the richness in calcium phosphate and silica may perhaps account for the great hardness of teak." Watts' Dict. Chemistry, 3rd Sup., p. 1894.

The sample from Nilambúr was in the form of a rounded flattened cake about 10 inches in diameter and 2 or 3 inches in thickness; dirty white in color, with a rough gritty surface. A sample was made for analysis by breaking off portions from different parts of the cake and reducing the whole to a fine powder. The powder examined under the microscope was mainly in an amorphous condition similar to prepared chalk, with a dark colored gummy matter, and a small quantity of crystalline quartz sand. The following is the composition:—

Calcium carbonate, ...	70 05
Tricalcic orthophosphate, ...	2·89
Quartz sand, ...	9·76
Organic matter, ...	14·30
Moisture, ...	3·00
Total, ...	100·00

The analysis shows that the principal compound is calcium carbonate, and the concretion approaches nearer the chalk or limestone formation than that of the apatite or phosphatic found by other investigators. An examination of deposits from other trees

might show greater differences than these, but it seems enough has been done to prove that the calcium element forms the base.

The sand, probably blown up as dust and made to adhere by the organic matter, is a mechanical ingredient. The deposit contained no salts of sodium or calcium soluble in water, nor any ammoniacal compounds; this would stand to reason, as the heavy rains to which this district is subjected would scarcely leave anything soluble on the trees.

A sample of the soil from the Teak Plantations, the same as that in which the Ipecacuanha is being cultivated, has also been examined. It is a light reddish brown sandy loam with quartz. In a dry state it contains 79 per cent. of silica and silicates, about 5 per cent. of organic matter, the same of iron oxide and alumina, and ·217 per cent. lime a as oxide.

The scanty amount of lime present in the soil, and the large amount found in the tree, show what an enormous quantity must have been taken up by the sap. I have shown elsewhere that a full sized cinchona tree contains about 10 ounces of lime (as slaked lime), not concentrated by abnormal development in one place, but distributed in all its parts. A teak tree from its size and ash contents would have a much larger supply than a cinchona, and yet, it seems, is able to excrete it in some abundance. In what manner this takes place is not easy to determine. The calcium enters the plant in a soluble form as sulphate. The calcium unites with oxalic and other acids and is precipitated, while the sulphuric acid parts with its sulphur to form organic compounds. A wound in the tree is liable to render these processes abnormal by causing the vegetable acids to ferment by exposure to the air and to yield carbonic acid as one of the products, and this meeting with the calcium in the ascending sap exuding from the wound might convert it into an insoluble calcium carbonate which would harden in the cavity of the tree and form the deposit.

D. Hooper.

TIMBER *VERSUS* METAL SLEEPERS.

The following notes from recent numbers of "Indian Engineering," represent the opinions of competent authorities regarding the relative value of deodar *versus* metal sleepers.

A first-class deodar sleeper 10′ × 10″ × 5″ costs on an average at Lahore Rs. 3-2, and this sleeper when fully equipped with chair, spikes, &c., costs Rs. 4-6-6 when laid on the roadway. On the other hand, the price of a fully equipped oval bowl metal sleeper is Rs.

7-11-6, or Rs. 3-5-0 in excess of the cost of a deodar broad gauge sleeper. It should also be noted that metal sleepers are much more liable to damage during transport than wooden ones.

It is further shown that the cost of ballasting a line laid with wooden sleepers is more expensive than that of a line laid with metal ones, so that finally the saving is reduced to Rs. 2-1-2 in favour of the wooden sleepers.

"The age to which a wooden sleeper will do its work, is, in common with the metal sleeper, dependent to a great degree on the description of maintenance it receives. Taking a first-class deodar sleeper, the road it is laid in, well maintained, the traffic—the average traffic of a Northern India line—I fix the age to which it will attain before demanding removal at 20 years.

"The age of the metal sleeper under exactly similar conditions may, I think, be taken at 40 years.

"In many parts of Northern India traversed by railway, where the quantity of salt in the earth is very excessive, this 40 years of life I have given is liberal to a degree. Salt is disastrous to the metal sleeper, so much so, that in these salt plains I am confident a wooden sleeper would outlive a metal one. I will, however, to strengthen my case, take no advantage of this fact, but will allow the age of the metal sleeper to be 40 years."

In comparing the relative cost of maintaining the two different classes of roadway, it appears that there is a saving of Rs. 53-8, per mile, per annum, in favour of the timber sleeper line of railway.

It is also generally admitted that the tear and wear of rolling stock and the damage done to the rails is much less on a timber road than on a metal one, which fact represents a further saving of no small importance in favour of wooden sleepers.

Again it is explained that in the case of minor accidents, which are the most common on Indian lines, it is found that the damage done to the permanent way and rolling stock is always much greater in the case of lines laid with metal sleepers.

In such accidents the metal sleepers are generally smashed to atoms, whereas on lines laid with wooden sleepers those suffer little, and the damage done to rolling stock is usually trifling. The writer then goes on to show that at the end of 20 years the total saving, effected on a line laid with wooden sleepers will be Rs. 10,026 per mile on account of original cost and maintenance, and that after having relaid the line at a cost of Rs. 6,400 per mile, which will carry it on for another period of 20 years, or equal to the whole life of the metal sleeper roadway, there will still be a net saving of Rs. 3,626 in favour of the timber road.

"What amounts could be added to this, on account of the longer life bestowed on rolling stock and rails, and what on account of savings in accidents (all due to the timber road) it is impossible to say, but I do not think I am giving too much in favor of the timber sleeper, if I say that the cost of minor accidents (and these, be it remembered, are the ruling accidents in India, and are besides very numerous), is ten times as much on 'metal roads' as on timber ones.

"There is another point in favor of the wooden sleeper, to which I have not yet alluded; this is, rate of exchange between India and Europe. My pricing of metal sleepers is based on figures which existed 6 months ago, but are now larger by reason of a falling exchange, and with a prospect of a further fall the advantages of using timber sleepers locally produced is still more apparent."

Several interesting remarks are made by one of the writers regarding the relative qualities of timber for sleepers, which may be summarized generally as follows:—

"The best building timber in the Punjab is *deodar*, which is obtained in large lengths in the hills. It possesses *strength*, *hardness*, *stiffness*, and *durability*, and is, therefore, well fitted for sleepers on the railway, entailing less wear and tear to rolling-stock, less breakage of sleepers in case of accidents, and also being much cheaper than other kinds of sleepers.

"For broad as well as narrow gauge, it is equally good, and is easily obtained in large quantities, at convenient places. Best heart-wood should only be used, and all defective wood rejected, it should be entirely free from sap-wood, large, and loose knots, flaws, shakes, and splits, and should be well seasoned. *Picked heart-wood* is free from the attacks of white-ants, and the ravage of other insects."

In conclusion, one of the articles contains the following important observation with regard to the desirability of Government retaining its money in the country instead of remitting it to Europe on account of the purchase of metal sleepers, in which case the Indian Government sustains a still further loss on account of exchange:—

"That it is to the interests of the Government to keep its money in this country cannot be contradicted. The people of this country, both Europeans and natives, are entitled to benefit directly, as well as indirectly, by the making of railways. The Indian Government has laid down an order, that when articles of local (*i.e.*, country) produce compare favorably, in description and cost with articles of European manufacture, they are to receive preference by officers purchasing on behalf of Government. In the matter of sleepers the Government should go further and give the Indian deodar sleeper the preference of the metal one, even if it were proved to be more expensive. The liberal use of timber sleepers being assured, capitalists would invest capital in growing timber and producing sleepers. Large areas of land in the hills, now barren, would be planted,

and the country opened up, and employment would be found for a large number of Europeans and natives who can now find none.

"Proved, however, as it easily can be, that the timber sleeper is cheaper than the metal one, both in initial cost, and throughout its life, it is imperative on the Indian Government to encourage its production in every possible way, and to secure for its own use every decent sleeper offered."

COMPARATIVE TEMPERATURES ON HILL STATIONS AND IN THE PLAINS IN THE NORTH-WEST PROVINCES, INDIA.

A GLANCE at the daily weather reports issued by the Meteorological Reporter to the Government of India, will show that during certain times of the year the minimum or early morning air temperatures at the hill stations 5 or 6,000 feet above the plains are very little lower than at the plain's stations. Indeed, there are days when the temperature on the hills in the early morning is actually higher than in the plains. That this should be the case is explained by the action of radiation which causes cold air to accumulate in the plains whilst the overlying air is comparatively warmer. This has been demonstrated in a remarkable manner in Dehra Dún by means of the scaffolding previously described in the "Indian Forester." The air 66 feet above the ground was found to be as much as 12 degrees warmer during the early morning than the air 4 feet above the ground. This effect of nocturnal radiation shows itself also when the plains and mountain tops or ridges are compared with each other. To make this very evident, temperatures were observed at the exceptional height of 9,000 feet above the sea, at Deoban forest chauki in the Jaunsár Division, North-Western Provinces Forest Department. Simultaneously the temperatures were also observed at Dehra Dún in the forest office and 7 miles out (south-east) near a forest camp, called Rámgarh, in midst of a sál forest. Both latter places are about 2,000 feet above the sea, and therefore 7,000 feet below Deoban.

Unfortunately the temperatures at Deoban were observed half an hour later every day than at Dehra Dún and Rámgarh, but allowance can be made for this. The annexed table shows that there is as much difference between the Dehra Dún office station and the forest station of nearly the same height above sea level as there is between the latter and Deoban.

The Deoban station is only 3 degrees below the Rámgarh forest station. If we allow 2 degrees on account of the difference of time, we will have Deoban 5 degrees lower than Rámgarh, and 8

degrees lower than Dehra Dún forest office in the mean. On the 27th of December, Deoban showed actually a higher temperature than the two lower stations; on the 29th, Deoban exceeded Rámgarh; on the 7th of January Deoban equalled the mean of the two lower stations.

It is intended to establish regular meteorological observations at Deoban in the course of this year, when more reliable comparisons will be possible.

Date.	Dehra Dún Forest Office, above 2,000 feet.	Rámgarh Forest Camp near Dehra Dún, about 2,000 feet.	Deoban Forest Chauki about 9,000 feet,
	7-30 A.M.	7-30 A.M.	8 A.M.
15th Dec., 1887,	42	40	34
16th ,, ,,	39	38	34
17th ,, ,,	40	38	33
19th ,, ,,	38	36	35
20th ,, ,,	44	41	35
21st ,, ,,	40	38	35
22nd ,, ,,	44	39	36
23rd ,, ,,	44	42	37
24th ,, ,,	42	40	35
27th ,, ,,	35	34	38
28th ,, ,,	39	33	34
29th ,, ,,	35	33	35
30th ,, ,,	37	34	35
31st ,, ,,	35	35	31
2nd Jan., 1888,	38	34	32
3rd ,, ,,	36	36	32
4th ,, ,,	36	36	32
5th ,, ,,	38	35	33
6th ,, ,,	38	36	33
7th ,, ,,	36	34	35
9th ,, ,,	37	34	33
10th ,, ,,	38	37	35
11th ,, ,,	39	38	35
12th ,, ,,	43	36	36
13th ,, ,,	41	38	34
14th ,, ,,	40	38	33
16th ,, ,,	51	43	39
17th ,, ,,	38	38	33
18th ,, ,,	37	34	26
19th ,, ,,	35	34	27
20th ,, ,,	35	35	26
21st ,, ,,	44	36	28
32 days Mean.	39·2°	36·7°	33·4°

COMPOUNDING FOREST OFFENCES.

In a note on page 73 of the "Indian Forester," the Editor explains that the plan of compounding forest offences works admirably in the N.-W. Provinces. The Divisional Forest officers personally examine the offenders, and do not send petty cases to a Magistrate. When any important case is sent up to a court, the opinion of the Government vakil is generally first obtained on the subject. I think some further information concerning the procedure of sending for the witnesses, &c., will be instructive. What is done in case a witness, or an offender, does not wish to appear before the Divisional Forest officer? Is the Protective Forest staff of the N.-W. Provinces sufficiently strong to arrest and convey forest offenders to some long distance, where the Divisional Forest officer resides or encamps? If the arrest is made at evening, is the offender kept in custody, if so, how is that done?

Do the witnesses consent to come up to the Divisional Forest officer on their own accord?

If an offender refuses to give compensation, is he detained in custody until the opinion of the Government vakil has been obtained?

Does the Police, if called upon to interfere, bring up the offender before the Divisional Forest officer before taking him to the court. In short, the personal enquiry of Divisional Forest officer into all the forest cases seems to be somewhat impractical in Divisions with detached forests, specially when Divisional officers have to attend to their multifarious duties of out-door and office work.

3rd March, 1888. S. S.

The Forest Divisions in the N.-W. Provinces are fairly compact, the distance to be traversed by the Divisional officer rarely exceeding 20 miles from a central point.

In serious cases, offenders are at once arrested by the Forest Guards and brought before the Divisional officer; in other cases, the Range officer merely reports to the Divisional officer, and the latter then fixes a place and date suitable to all parties for enquiring into the case. As Divisional Forest officers are always moving from point to point of their Divisions, except during the four monsoon months, when offences are rarely reported, there is practically no difficulty in this procedure.

In more serious cases, offenders may be kept in custody until they can be brought before the Divisional officer, or until the Range officer has sufficiently investigated the case to report it. Each Forest Guard has his chauki, and chaukis in the School Circle are now being built in a permanent manner, and the offenders can readily be kept there for one night if necessary.

As a rule, offenders are either shikaris, purchasers of forest produce who have grass huts in, or close to, the forest, or villagers who live in its proximity, and occasionally petty dealers from a town. Such men can be released and brought up for enquiry, whenever required.

There is seldom any difficulty regarding the attendance of witnesses to forest offences, and they are generally Forest Guards or purchasers of forest produce.

In the case of offenders refusing to pay compensation when the Divisional officer may consider their offence proved, and has proposed it, the case, if a serious one, is shown in writing to the Government vakil, and if he considers the case a good one, report is made to the Magistrate, who fixes a date for hearing the case. Pending the report of the Government vakil, the defendant is released and returns to his home.

In certain cases, where the evidence appears to be sufficiently clear, the case is at once sent to the Magistrate, the Forest Guard or Range officer conducting it personally.

It is very seldom that the assistance of the Police is required, the Forest staff being quite strong enough to arrest offenders, and the people being generally ready to submit to their authority. Our forest chaukis are much more numerous than Police thánahs, and application to the Police in purely forest offences hardly ever occurs, though in offences under the Penal Code, it may be necessary. Forest officers in the N.-W. Provinces spend 8 months every year in camp, and being constantly in their forests, have no difficulty in attending to their duties, however multifarious they may be, and always consider enquiries into forest offences as above all their other duties —[Ed.]

NOTES ON INSECT RAVAGES IN PINE FORESTS.

The study and prevention of disease in forest trees is of such great importance, and so intimately connected with the prosperity of forests, that a few notes on a disease in the form of a pest of insects, which has done extensive injury in many of the pine forests under my charge (the Sutlej valley, Bashahr), may be of interest.

The pest to which my notes refer, made its appearance during the summer of 1882, and spread at an alarming rate over large areas. Young, vigorous trees invariably shook it off, but less hardy ones were either rapidly killed, or after lingering for some time, died out. The leaves of infected pines turned an unhealthy yellowish color, and the branches dried and curled up into claws, giving a most wretched appearance. At the end of the rains, the disease abated, and to all seeming disappeared, and for four years the forests were free from its ravages. But in June 1887, it returned, and this time attacked both the *Pinus excelsa* and *Pinus Gerardiana*. In July, I noticed that the leaves of the affected trees were beginning to change color, and that the insect had preferred, for first operations, the ends of branches, and that it had tunnelled out, between the bark and the sapwood, longitudinal galleries, which, on close inspection, I found to contain larvæ and weevils.

I continued to observe these during the rains, and I suspect, that the hollowed out interiors of the tender shoots are designed for the reception of eggs, and the rearing of larvæ, as later on, when no more larvæ remained, the perfect insect abandoned the tender shoots for larger branches, through which it worked holes as far as the heartwood, and in the direction of the axis of the stem. Branches thus attacked were tattooed all over and did not survive long. No eggs or larvæ were, however, observed in them, and I think they are merely scooped out to obtain food. This destructive insect belongs to the order Coleoptera, and is probably some species of Bostrichus. It is one-tenth of an inch long, with dull brown colored elytra, and its larva is a small white grub of the same length, but as I am sending you specimens of larvæ and perfect insects for identification, I will not attempt to describe it further. Its duration of activity is three months, which is as long as the rains last, for at the end of September, its depredations ceased, and in October, I had difficulty in finding any beetles alive. But doubtless, they leave behind in dead wood ample deposits of eggs which are hatched on some favorable atmospheric change occurring.

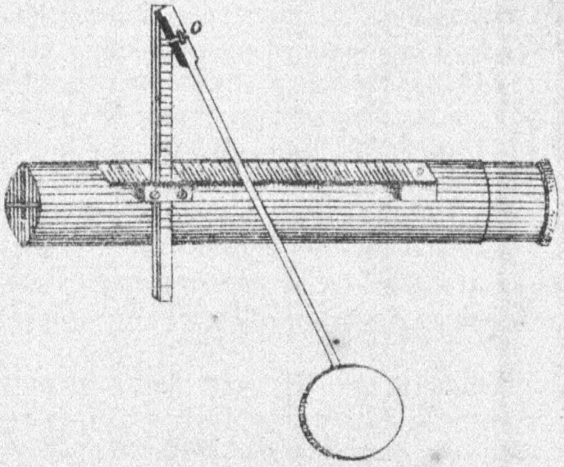
At Changa Mangá in 1875-76, after large thinning operations, the ground was littered with refuse wood, and a similar pest occurred. I was, therefore, in the present instance inclined to attribute the origin of this beetle to forest litter, which in the forests of this Division is composed chiefly of branches of the deodar trees felled annually, and of the loppings left by the people in forests open to rights. In spite of periodical efforts to collect and burn such refuse, there always remain, particularly in the unclassed forests, large quantities of decaying litter, which is well known to harbour insects. I failed, however, to discover in collections of forest refuse any trace of the weevil described above, and I must suppose that the outbreak is due to some other cause. The only remedy which suggested itself at the time was to lop off all tainted branches on the first sign of the disease, and remove the trees that had gone too far. Besides, insectivorous birds have always been protected. But there may be other well known means of preventing and stopping the development of diseases in trees, caused by insects: and I hope some of your correspondents will be good enough to throw some light on the subject.

G. G. M.

Specimens of the larvæ of the insects attacking the pine trees and of their ravages have been received, and will be sent to the Indian Museum, Calcutta, with a printed copy of the above paper.—[Ed.]

WEISSE'S HEIGHT MEASURER.

WEISSE'S instrument for measuring heights consists of a tube which pulls out and is provided with cross wires, and with a scale of heights which rests on it lengthways, and a scale of distances which is fixed upright. A pendulum is also attached to the scale of distances at the upper end O. When not in use, the tube serves as a receptacle for the scale of distances and the pendulum.

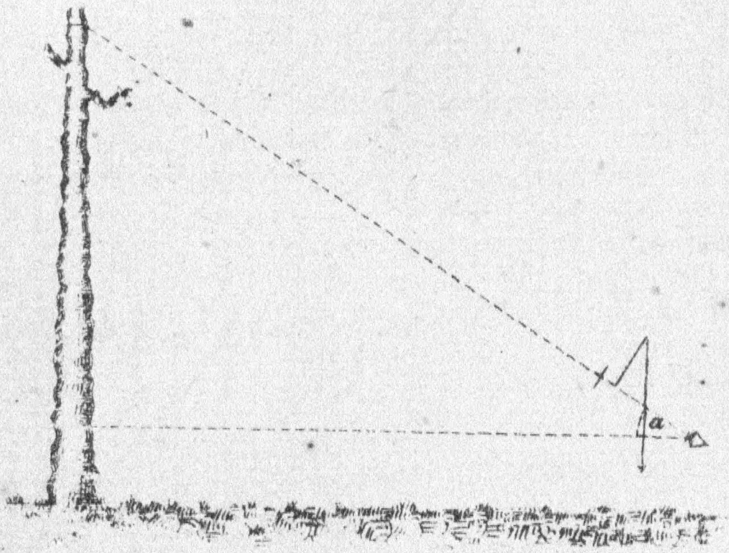


If it is desired to determine the height of a tree, we select a point from which the foot and the top of the tree can be seen. The line from the tree to this point is used as base line and is measured. Its length should be as nearly as this can be estimated equal to the height of the tree. The true length of the base line is measured.

The scale of distances which is fixed upright to the tube is then so moved that the projecting upper portion of the scale indicates the length of the base line. (The scale is in metres, but for use in India it could easily be changed into feet). This done, the tube is held in the right hand, brought to the eye and directed to the top of the tree.

The tube is so turned that the cross wire appears vertical, and the top of the tree is made to cover the centre of the cross wire. Maintaining this direction of the tube, the latter is then slowly turned round its axis from right to left and back again. This is repeated two or three times, and then the instrument is taken from the eye. The scale of heights is provided with teeth, which stop the pendulum. The number of the scale at which the pendulum is stopped represents the height of the top of the tree above the eye.

To find the full and true height of the tree it is necessary also to direct the tube to the foot of the tree. If the pendulum is stopped this side of zero, the number indicated on the scale is to be deducted from the former height. If the pendulum is stopped on the other side of zero, the number on the scale is to be added to the former height.



The whole theory of this instrument is based upon the similarity of rectangular triangles, as shown by the diagram. When (*a*) and (*b*) have equal scales, and (*b*) is fixed corresponding to the measured base line (B), it follows that (*a*) must stand in true relation to (A). The height of the tree is marked by the stopping of the pendulum.

Manufactured by Th. Buddendorff, Mechanic, Schützenstrasse, No. 53, Berlin, S. W.

We hear with great regret that the recently established New Zealand Forest Department has been abolished, the new ministry in that country apparently thinking that the forests will last their time, and that if ruin should come hereafter on this hitherto flourishing Colony that at any rate they will not be there to see it.

JJ. REVIEW.

THE FINANCIAL STATEMENT, 1888-89.

WE read in the Summary of the Hon'ble Mr. Westland's Financial Statement for 1888-89, that "*the Post Office, Telegraph and Forest, all of which may be regarded as quasi-commercial Departments, are more remunerative every year.*"

The figures under *Forest* are as follows :—

Accounts for 1886-87.	*Revised Estimate,* 1887-88.	*Budget Estimate,* 1888-89.
	REVENUE.	
Rs. 1,10,39,700.	Rs. 1,14,17,000.	Rs. 1,17,16,000.
	EXPENDITURE.	
Rs. 71,97,650.	Rs. 76,33,000.	Rs. 77,06,000.
	SURPLUS.	
Rs. 38,42,050.	Rs. 37,84,000.	Rs. 40,10,000.

Mr. Westland also makes the following remarks about *Forests* :—

"Under 'Other principal revenue heads' is included the Forest Revenue, under which, at present, we get a revenue of Rs. 1,15,00,000 by an outlay of about Rs. 75,00,000, or 68 per cent. on income. The percentage in the State Forests of Prussia, in which country Forestry has reached an advanced stage, is very nearly the same, being 62 per cent. on a revenue of about 2½ millions.

"The percentage in India is gradually improving. Both in India and in Prussia the income is considerably diminished by the large amount of forest produce which has to be given free to local right-holders.

"Still the present occupation of the Forest Department consists more in building up a most valuable property for the future than in realising a revenue in the present. In Burma the teak forests furnish a handsome revenue; the Sub-Himalayan forests, from which large supplies are brought down for the consumption of Northern India, and the Sunderbans near Calcutta, are also revenue-producing areas. The Bombay forests are also productive in teak. But hardly anywhere is the expenditure less than 50 per cent. of the Revenue, and in many places it is much higher. The work of the Department is at present, in fact, rather con-

servation and development than production of revenue. Centuries of neglect and denudation have to be remedied by systematic reservation, planting, and exploitation, and the return which the Department at present gives to Government is in the rapidly increasing value of the Government forests, rather than in the revenue immediately brought into the Government treasury. The net revenue, however, is satisfactorily progressing, having during twenty years, increased from Rs. 13,00,000 to Rs. 40,00,000."

We do not quite agree in the statement that a large amount of forest produce *must* be given free to local *right-holders*, very much of this large amount is given by executive grant, as a free gift by the Local Governments without the recipients having any *right* to it at all.

This generosity is doubtless in some cases warranted by circumstances, but in others, where the free gifts of forest produce allow neighbouring land-owners to increase their rentals and establish cattle breeding stations at the expense of Government, it is evident that the country at large is taxed to enrich individuals, whilst the forests subject to this wasteful treatment are rapidly deteriorating, so that in the last Annual Report of the Oudh Forest Department, the Conservator seriously raised the question, as to whether the maintenance of establishments to look after such privilege-ridden forests were any longer advisable.

It would surely be more advantageous to the State to sell forests, where the use of privileges granted by the Local Governments altogether prevents any improvement, and private owners would then either bring them under cultivation or take measures to protect them from misusage, as is now the case with many of the private sál forests in the Dehra Dun District of the N.-W. Provinces, for strange to say, no sooner is a State forest alienated by sale, than it is found that all *so-called rights* in it entirely disappear.

JJJ. Official Paper.

MEMORANDUM ON THE SYSTEM OF MANAGEMENT OF THE SUB-MONTANE FOREST DIVISIONS OF THE CENTRAL CIRCLE, NORTH-WESTERN PROVINCES AND OUDH.

1. The system styled, by order of Government, "the Revenue Depôt and Permit System" is in force in the following Divisions :—

	Area, square miles.
Kumaun Division, ...	535
Garhwal „	500
Ganges „	349
Total, ...	1,384

2. It is difficult to describe with lucidity the system of management without reference to maps. The forest charges, revenue depôts, main lines of export, adjacent towns, and railways, are entered on the 1-inch map sheets of Kumaun and Garhwal, Bijnor, the Tarai, and Moradabad ; and in a few months the Forest Survey has promised to bring out a new edition of the ¼-inch index map of the Himalayan Divisions of the Circle ; but, pending the receipt of this, there is no handy map to which reference can be made.

3. The three Forest Divisions have been divided into 13 Ranges, or executive charges. Of this number, three Ranges (except in connection with the repairs of certain export roads on the boundaries of, or beyond, the forest area) deal with revenue collections only. The three Revenue Rangers have seven Foresters subordinate to them, who have allotted beats. The other ten Ranges embrace the entire forest area. Two of the number—

	Area, square miles.
Udepur, ...	54
Kotah, ...	55

have not yet been sub-divided into Foresters' beats. The remaining eight have been divided into 19 Foresters' beats, or protective charges subordinate to Range Officers. The ten Ranges, again, are divided into 94 Forest Guards' beats, immediately subordinate, in two cases, to the Ranger; in others to the Foresters of the different beats.

The average area of a Range is 138 square miles; the smallest Range including 52, the largest Range 214, square miles. The average area of a Forester's beat is 71 square miles; the smallest including 17, the largest about 100, square miles. The average area of a Forest Guard's beat is 15 square miles; the smallest including about 4 square miles, the largest about 24 square miles.

The variation in the size of the different charges is due to the fact that certain tracts of forests (notably at the head of the Palani, and to the north of the Ramganga and Mundal rivers in Garhwal, and on the Ladya and Sarda rivers in Kumaun) are difficult of access and little or no work is in progress therein, so that the duties of the Protective Staff are mostly confined to simply guarding the forest.

4. The division of the forest area described in paragraph 3 is tentative only; and, as the demand on the forests and forest work increases, the number of protective charges will increase, and the average area per man be reduced. Provision for this has been made in existing sanctions, which include allotments for a larger number of Rangers than we now employ. As better qualified Rangers are available, new beats will be formed for the Foresters now in charge of Ranges; and, as the works render it necessary, existing Forest Guards' beats will be sub-divided.

With one exception (the Patli Dun Range—area, 214 square miles—which is now admirably worked by an exceptionally good Ranger), the present number of Ranges will suffice for a good many years to come; and provision for creating the one additional Range, when required, has already been made.

The crying wants of the three Divisions are the services of an additional Sub-Assistant Conservator and of some first-rate men who have attended the Ranger's course at the Forest School. To meet the first want, I regret to say no apparent progress has been made. As to the latter, there are now four students at the Forest School, three more join in July 1887, and, I hope, three more will join in 1888. Four men have obtained the Ranger's or Forester's certificate, of whom one is in charge of a Range, two are in charge of Forester's beats, and one is on special duty (but will from

November be in charge of a Range). Present arrangements, therefore, will give us 14 trained subordinates by 1890.

There is much difficulty in obtaining suitable men of sufficient education for the Rangers' class, as the climate and life are not attractive to boys at the higher class of schools ; but it is hoped the recruits obtained will turn out well, and additional men be obtainable as required.

5. Working-plans of a more or less permanent character have been drawn up for about 448 square miles of the 1,384 square miles of forests. The remaining 936 square miles are worked under annual Plans-of-Operations, which, it is hoped, will, in many instances, be soon replaced by forecasts for terms of five years. For about 130 square miles of forest in the Kotri and Patli Dun Ranges, a permanent working-plan is required ; but the Government has as yet been unable to allot an additional officer to the Circle, and so render it possible to take this work in hand. The semi-permanent working-plans are required for tracts—including the South Patli Dun, Rehar, Garhibul Chand, in Garhwal ; Horai and Lakhman Mandi, in Kumaun—where continuous protection from fire has improved the forest growth ; and the time has arrived when regular thinnings will be advantageous in every way. These plans will be drawn out by Divisional Officers. Subject to the changes noted, the forests are, as far as the Department's power extends, satisfactorily worked ; the chief difficulties and shortcomings arise from local forest rights and customs, which are, too often, opposed to any good system of management, and which it must be a work of time to put on a sound footing. There is, however, progress to be noted in this connection, as District Officers and others now begin to appreciate the preservation of forests, and grasp the difficulties caused by the old Forest Settlements, founded on so-called expediency rather than on any scientific basis or real consideration for the common weal.

6. Forest Work in these Divisions may be described under five heads :—

I.—General Protection.

II.—Communications and Buildings.

III.—Fire-protection and special works of Improvement.

IV.—Regulation of the removal of Forest Produce.

V.—Revenue collection.

All duties (save as specially noted hereafter regarding the issue of certain permits for No. IV.) in connection with the first four are vested in Range Officers, who, again, under certain standing orders, assign special duties and a given amount of responsibility

to their Foresters and Guards, who are, for about five months of the year, assisted by a large staff of fire-watchers.

With regard to heads Nos. I. to III., it seems needless to note in detail the duties of a Ranger, Forester, and Forest Guard ; and it is only necessary to say that they are based on each man having defined duties in his charge, and, save in exceptional cases—such as the main fellings of a year being made in a Forest Guard's beat, a complicated building being erected, or a permanent and difficult road being made—responsible up to his powers for all the work in progress therein.

When special works such as are alluded to above are in progress, the Forester of a beat has additional Forest Guards, with, if necessary, a junior Forester placed under him ; but the principle of defined duties and undivided responsibility is still maintained.

7. With regard to IV.—the regulation of the removal of forest produce—forest produce may be classified under the following heads :—

(*a*). Green timber.
(*b*). Bamboos.
(*c*). Dry wood, for timber or fuel.
(*d*). Grass and other minor forest produce.
(*e*). Grazing.

I may incidentally remark that the fellings of green timber are, with very few exceptions, made in the areas under fire-conservancy, which now include some 390 square miles, embracing the most valuable sub-montane forests. This area is annually being increased, as the difficulties of Tarai fire-conservancy are grappled with, and a fair chance of success in fresh areas can, with confidence, be hoped for.

The green tree fellings of each year, except of trees claimed by right-holders, mostly given on indents sent in at fixed times of the year and marked when the indents are passed, are placed the season preceding the time of felling, and most of the trees to be felled marked, under Divisional Officers' supervision, by the Range Officers, with the aid of their Foresters, immediately after the fellings are sanctioned. For the removal of inferior kinds of trees to promote the growth of sál, &c., and the thinning of poles, the marking is generally done the season the cuttings are made. The main lines to be followed in the allotment of green trees are communicated by the Divisional to the Range Officer ; but in some cases—such as sain or haldu fellings—the Divisional Officer, after fixing the rate (by tenders or otherwise), allots the trees by a definite order to the Range Officer.

Subject to the above notes, Range Officers issue permits for working green timber, and arrange details for checking conversion and regulating the export.

A special establishment is assigned for extensive timber works (such as the removal of 10 to 60,000 cubic feet), which, under the Forester of the beat, attends to the following points :—

(i). The felling of marked trees, method of felling, and registration of felling.

(ii). Checking conversion to prevent waste.

(iii). Registering outturn by compartments, and granting passes to remove to revenue depôts. In small timber works, the Forester has to supervise them, through his Guards, on similar lines.

(*b*). For bamboos, permits to cut are issued by the Range Officers, who, as far as possible, assign large tracts to a single big cutter, or to the headmen of cattle stations, who are then answerable for their employés, who actually cut the bamboos. This plan has been found to work well, though the present four-stem rule, the basis of our bamboo cuttings, must still be regarded as on trial only.

(*c*). For dry wood, there is a double arrangement: any merchant wanting to convert and export dry wood on a large scale is assigned an area by the Range Officer, and permits to work are issued by him.

For petty converters or exporters from the north of the forests the Range Officer or the Forester of a beat issues permits to work ; for similar applicants from south of the forests, permits to work are granted by officers in charge of revenue depôts, who once a day forward a copy of permits issued to the Range Officer concerned, who notes and passes them on to the Forester for communication, if necessary, to his Guards and for record.

In connection with the conversion of dry wood, two points require attention on the part of the subordinates—

(i). To see no waste takes place in conversion.

(ii). To see no wood is cut up into fuel that would yield timber.

With reference to the latter point, the revenue depôt establishment aid, as they are ordered, to stop valuable wood brought out as fuel, and either charge for it as timber, or, if the exporter objects, to detain the wood and report to the Ranger, quoting permit and locality when enquiry is made.

(*d*). For grass and minor forest produce, permits to work are

granted as for petty converters or exporters of dry wood, and the latter procedure is similar.

(*e*). Grazing is of two kinds :—

(i). From cattle stations inside the forests.

These stations are allowed under the Conservator's sanction, and subject to the terms of special stamped agreements given by the headman. The dues from these stations are collected by the Range Officers concerned, under special rules, and forwarded to the nearest revenue depôts for remittance to the treasury.

(ii). Grazing by exporters.

Passes for these cattle are issued at revenue depôts, and are honoured by Range Officers, whose duty in connection therewith consists in seeing that cattle are covered by passes, and that any areas reserved for exporters' cattle only are only grazed under these passes, and that areas closed to grazing are not infringed on.

8. V.—*Revenue collection.*—This, as noted in paragraph 3, is placed under a special Range Officer. The collections are made at revenue depôts, established on main lines of road from the forests to the neighbouring towns. The main feature of the collections is that dues are levied on converted produce, cut logs, sawn karis, trimmed poles, fuel, grass, hides, gums, &c., &c.

The rates leviable are noted in a sanctioned table of dues ; some of these dues—such as the rate for green timber from forests at varying distances from the markets—are liable to annual revision; but the majority are more or less constant. The rates for timber are fixed with reference to the market value of the converted produce : thus large sál cart shafts for the Delhi and Meerut markets pay Re. 1-4-0 a cubic foot ; other large sál timber, 12 annas to Re. 1-2-0 ; while a bed-post or wall-peg pays 4 annas to 6 annas.

This system is believed to obtain the best price for the trees, as the merchants who convert and generally export the timber indent for trees suitable for their specialities, and arrangements are made for utilizing to the best advantage the felling of the season. In former years, most of the green timber fellings were carried out departmentally, as being more profitable ; but experience has shown that, carefully supervised, as noted in paragraph 7, the yield per tree has been sensibly increased, and the net profit, after allowing for the enhanced value of timber, been raised. The system also considerably fosters trade, as it enables merchants (without risk to Government) to postpone payment of forest dues until just before they are ready to take their goods to market. Facts have proved that this advantage is appreciated and even partly discounted by

the trade,—*i.e.*, that, given this advantage, a slightly higher price is willingly given for timber.

As regards bamboos, it is eminently suited to the class of traders who resort to these forests, and attempts to sell blocks of bamboo forest which had been closed for some years to cutting failed, though the merchants later on willingly paid enhanced rates for the bamboos cut therein.

For minor products, including fuel, the system seems to work well, as compared with experiments made in selling outlying forest blocks (such as Rehar) by auction, where the receipts from depôts were higher, while the trouble of realizing was less. The attempts to lease Rehar and similar forests will, however, be persevered in, as there is every reason to suppose that forests nearly surrounded by cultivation (*and unembarrassed* by rights, as these forests are) should be saleable at remunerative prices.

9. The Revenue System requires brief notice. The position of the forests in a long belt along the foot of the hills, with no purchasers from the north and a zone of either grazing lands, or right-holding or locally provided villages, below its southern boundary, renders a unique and effective plan of collecting revenue possible. The southern boundary lines of the three Divisions are approximately as follows :—

	Miles.
Kumaun Division, ...	89
Garhwal „	28
Ganges „	73

On these lines, at main points of exit, 13, 14, and 21, revenue depôts of the three Divisions are located ; while from two to seven miles below the boundary, at convenient villages above the consuming area, and situated on main export roads, 13, 17, and 14 revenue check depôts are located.

At the revenue depôts, the exporters pay the dues on produce converted under the permits previously referred to, obtain a receipt pass, and, within a given time, convey it to the appointed revenue check depôt, where, after examination, check, and correction of any errors, an export pass is issued.

The establishment maintained in revenue depôts is one or, in the case of the four largest depôts, two Forest Guards or Foresters, drawing from Rs. 8 to 15 a month, and two (or in large depôts three) Forest Guards for the post and general duty.

In a revenue check depôt, a Forest Guard is maintained, with, in some cases, one junior Guard for post, &c. The line of revenue

check depôts is divided into seven beats, each under a Forester (referred to in paragraph 3), who constantly moves up and down the check line, keeping the men up to their work and, among other duties, collecting the receipt passes from each depôt, and forwarding them for compilation to the Divisional office.

Along the depôt line, a postal service for revenue and letters runs from the Sarda to the Ganges, which linked with off-shoots from main points, serves the entire forest area.

The management of all the depôts, post, revenue payments, and primary accounts rests in the hands of the Ranger in charge of the Revenue Range, with this reservation that each Ranger in charge of a Forest Range has the power to visit any depôt in his Range, examine the books, and, if necessary, stop produce he has just cause for supposing is being exported against rules. This system, while it maintains the touch of a Ranger in charge of a Forest Range with the receipts from his forests, frees him from the responsibility for heavy money receipts and accounts, and directs the whole of his energies to his work inside the forests.

10. The heavy nature of the revenue work is shown by the following figures for the past year :—

Revenue, 1886-87.

	Total.	Per square mile.
Kumaun Division, ...	Rs. 2,04,902	Rs. 385
Garhwal „ ...	„ 1,52,586	„ 305
Ganges „ ..	„ 1,29,764	„ 372

Of the above, only Rs. 71,634 in the Kumaun Division was realized from Departmental works, leaving Rs. 4,15,618 as the amount collected by the revenue depôts from exporters. Of this sum, about Rs. 1,10,000 was collected during the month of March, the most important month as regards the timber works inside the forest, fire-conservancy, and, indeed, every description of forest work, and the time when all a Forest Range Officer's attention is demanded for his forests.

The cost of the revenue depôt establishment (*i.e.*, permanent and temporary, and including the whole cost of the postal service, which is of general utility) for the year was approximately Rs. 16,200 ; so the cost of collection may be taken at Rs. 3-3-0 per cent., or, allowing that the receipts in 1886-87 were unusually high, and that the same establishment would have been kept up for smaller receipts, we may say 4 per cent.

11. The establishment maintained under this system and ex-

penditure, it is believed, made the collections with a minimum of loss to Government, as the checks on illicit exports are as perfect as could be devised, and with the greatest facilities to exporters.

The questions demanding thought in connection with the Revenue (apart from the Forest part of the system) seem to be :—

(*a*). Is the cost of collection excessive ?

(*b*). Does Government by this system insure maximum exports from its forests ?

(*c*). Does Government obtain the highest price for its produce ?

As to (*a*), taking into consideration the fact that if we leased our forests, the lessees would have to maintain the establishment now entertained by us and would deduct the charges, plus their profits, from the gross value they would put on their leases, it is not apparent that the collection charges are high. Further, under any revenue system, the forest post would have to be maintained, and this absorbs men drawing about Rs. 500 a month. Lastly, any system would involve the detachment of a certain establishment to control the exports and money receipts ; and it is nearly certain that, deducting what I may style the lessee's proportion of our present revenue staff and the cost of the forest post, no perceptible residuum would be left, which we might draft into the forest for charge of beats, &c. As to the question of cost, I may mention that every effort is made to keep the revenue establishment as low as is compatible with efficiency, and that improved roads below our forests have helped to close many cross-country tracks, and so reduced the number of revenue check depôts ; while small improvements in the mode of selling, and in accounts, &c., have facilitated a reduction in the main revenue depôt establishments.

With regard to (*b*), I think the revenue system, save in the event of exporters being troubled by the rules enforced, and so deterred from entering the forests, really cannot affect the exports for ill, inasmuch as the system favours small and great alike, and, above all, does away with the middleman monopolist and divides his profits, we hope, between Government and the exporter.

It seems certain that the exports depend on the internal management of the forest, on the facilities offered by good roads, a civil hard-working staff (regarding the interests of exporters as only second to those of Government), and fairness in fixing the price asked for produce : these points include the whole round of our administration, and have little or nothing to do with the system of levying the forest revenue

With reference to (*c*), while it is easy to express an opinion, it is exceedingly difficult to give figures to support it. The chief cause of this difficulty is that, in more or less unknown degrees, the value of produce varies with the distance of the forest containing it from the market. A few examples may make my meaning clear. In 1883-84, sain timber was selling in the Dehra Dun Forests for about 10 annas a cubic foot, was only saleable in small quantities in the Patli Dun at 5 annas a cubic foot, and was practically unsaleable in Oudh at 1 anna 6 pies a cubic foot. In 1884-85, it was important, on sylvicultural grounds, to fell a large quantity of sain in the Patli Dun ; tenders were called for, 4 annas a cubic foot was the highest sum offered, and the offer was accepted, with the result that the trees due for felling were felled and the exports multiplied eight-fold. The opening of a railway, the demand for sain raised by the fancy taken to the timber, and the profits made in 1884-85, have since raised the rates to a maximum of 6 annas 6 pies in these forests ; at the same time the cost of carriage varying as follows :—

	Rs.	A.	P.
Kotri Dun to Meerut per score of 12 feet karis,	9	0	0
Patli Dun to Meerut „ „ „ „	13	4	0
Kasi Forest to Meerut „ „ by rail,	18	0	0
„ „ „ „ „ by road,	16	0	0

The rate obtained in different forests vary as much as 1 anna a cubic foot.

Again, in 1884-85, fuel in the most southern forests of Garhwal was readily saleable at 8 annas per two bullock carts, and limited sales were effected at 12 annas. At the same time, fuel six miles north sold slowly at 6 annas per cart ; at 12 miles was barely saleable at half rates ; and, when offered for charcoal free of charge 18 miles north, where the removal of fuel was urgent on other than revenue grounds, was simply left untouched.

Facts like the above show how difficult it is to compare the prices obtained in one place with those obtained in another. Generally, it may be claimed that, by means of the plan of calling for tenders for produce of varying value, and by feeling the markets as indicated in the very complete produce and revenue accounts, the Forest Administration of the sub-montane tracts in Kumaun and Rohilkhand does obtain a fair price for the produce exported, and does sell the produce on sound principles.

12. In conclusion, I would summarise the arguments of this Memorandum as follows :—

The method of collecting the revenue is only one part of the entire system of forest management.

The more important portions of the system are the general and internal administration.

Revenue and internal management, closely linked as they are and must be, should be separately considered and criticised.

As elsewhere, minor changes in administrative detail are constant, but, on the whole, the present system is suitable and works well.

Finally, it may be noted that the method of revenue collection possesses unique advantages peculiar to, and rendered possible by, the geographical position and circumstances of the forests, and that it is a method which could rarely be adopted elsewhere with advantage.

C. BAGSHAWE,
Officiating Conservator, Central Circle.

Dated 3rd June, 1887.

APPENDIX.

Specimen copy of Notice issued annually, prior to the open season, in the Sub-montane Forest Divisions of the Central Circle, North-Western Provinces and Oudh.

FOREST DEPARTMENT.

_____ *Division.*

(1). Under orders from the Conservator of Forests, Central Circle, North-Western Provinces and Oudh, Revenue Depôts for the collection of dues on produce exported, in accordance with the terms of this notice, from the forests in the ..... Division will be opened, at the places noted below, from the ..... 188 to the ....188 :—

List of Revenue Depôts where produce will be examined, dues collected, and receipts on export passes be granted—

I. .....
II. .....
III. .....
&c.

Note 1. At depôts marked thus,* only receipt passes will be issued; at other depôts, receipt or check passes will, as may be required, be issued :—

Note 2. Should it seem needless to keep all of the above depôts open for the whole season, any depôt will, after due notice, be closed.

Note 3. Export save by the roads in the vicinity of which the above depôts are situate is hereby forbidden.

(2). Exporters individually, or Agents in charge of gangs of workmen, wishing to prepare timber, or cut or collect other produce, will be furnished, free of charge, with season permits to work, on application, as follows:—

(*a*). For green wood or bamboos: to officers in charge of Ranges.

(*b*). For dry wood, grass, and other miscellaneous produce: to Foresters or officers in charge of Revenue Depôts for petty demands, or to Range Officers for large allotments of dry wood.

Permits are issued subject to the provisions of this notice and of the Forest Act and Rules.

Any person, or gang of men, working in the ..... forests without a permit will be liable to prosecution for trespass.

(3). Subject to the reservations noted in paragraphs 6 and 9 of this notice, all the forests of the ..... Division will be open to permit-holders from ..... 188 . to .....188 . for the export of—

(*a*). Dry wood of all descriptions.

(*b*). Bamboos.

(*c*). Minor forest produce.

(4). Standing green trees will be available as follows:—Sál near ..... to yield ..... c. ft. Sain near ..... to yield ..... c. ft. Haldu, Jaman, Dhaura, Khain, &c., are available in small quantities at ..... and ... ... Applications for green trees should be made to the Divisional Officer in ..... when intending exporters will be supplied with copies of the rules to be observed, and allotments of trees will be made. Trees not allotted in ..... will be allotted, on application, later in the season.

(5). Fallen green trees can be obtained on application to Range Officers, and, prior to export, the timber will be marked, and free forest passes given for delivery at the Revenue Depôts.

Any green wood presented for export unmarked, or without a forest pass, will be liable to confiscation, and the exporter to punishment for illicit export.

(6). Bamboos are open to cutting in all forests, subject to the rule that four entire growing stems shall be left in each clump. Headmen of bamboo cutting gangs, or of cattle stations, will be responsible that this order is observed, and infractions of the rule will be treated as cases of illicit cutting or export.

(7). The list of dues charged on timber, &c., and tables for measuring and pricing, can be examined at any Revenue Depôt, and the Divi-

sional Officer can supply spare copies at the following rates:—List of rates or dues at 8 annas each; tables for calculating cube contents and price of timber, at Re. 1 each.

The rates chargeable are the same as were in force in 188 -8 , save in the following instances:—

.....

.....

The special rates for standing trees can be ascertained on application at the ..... Forest Office.

(8). Any receipt pass not presented within the time noted below, at the depôt specified thereon as the checking depôt, will be liable to the payment of the following extra due:—

On passes of Re. 1 or less—8 annas each.
On passes above Re. 1—Re. 1 each.

Table of time allowed for the presentation of receipt passes, with produce, at depôt checking same—

From ..... to	hours.
.....	
.....	
.....	
All other depôts	hours.

Passes and produce delayed by accidents to carts, &c., will be exempt from this due.

(9). All timber brought to depôts, but on which forest dues have not been paid by the ..... day of ..... 188 , will, at 6 P.M. on that day, be liable to confiscation.

All timber, &c., under preparation in the forest will be assumed to be in the exporter's charge and at his risk from the time he begins preparation to date of exports or the closure of the Revenue Depôts.

Any exporter failing to export produce paid by him before the depôts close will, on the.....day of....., be held liable for the dues leviable on same, subject to the proviso that when he has paid the dues he may export the produce between the.....and the..... following; after the latter date, the produce, if unexported will be confiscated.

(10). Subject to further orders, the forests under fire-protection will be closed on the dates noted below:—

(*a*). Forest for conversion from .....
for export from .....

(*b*).	&c.,	&c.,	&c.
(*c*).	&c.,	&c.,	&c.

(11). The attention of exporters is directed to the provisions of the Indian Forest Act (VII. of 1878) and the rules framed thereunder.

Any notices issued in continuation of this annual notice will be post-

ed up at every Range Office and Depôt, and will, as far as possible, be otherwise generally made known.

By order,

(Sd.)

.....

..... *Conservator of Forests,*

..... *Division.*

Dated .....

..... *of* ..... *188* .

JY. TIMBER MARKET.

MESSRS. CHURCHILL AND SIM'S CIRCULAR.

MAHOGANY.—The year has opened well, the auctions have been largely attended, competition has been brisk, prices have advanced, and the tendency is still upwards.

SATINWOOD.—*East India*—The demand is dull and stocks rather heavy.

EBONY.—*Ceylon*—is quiet; there is a large stock of inferior wood, and the supply of good logs is sufficient for present limited demand. *Mauritius*—Wood of good sizes is asked for, but there is ample stock of other sorts. *Madagascar* and *Macassar*—are inactive.

BOXWOOD.—*Persian*—There is a fair demand and stocks are moderate. *African*—Good wood is asked for and small lots would sell well.

EAST INDIA TEAK.—The deliveries for the month amount to 1,817 loads, against 445 last year.

This large increase is due chiefly to the better demand for shipbuilding, but it should be remembered that teak is still comparatively cheap, and that there is nothing in the present level of price to check the very general demand which low prices have developed for this wood.

LONDON, *6th February, 1888.*

ANDAMAN PADOUK TIMBER.

THE barque 'Anne Main' left Port Blair on the 11th February with a cargo of 530 loads of padouk timber for the London market. Should this timber be sold at remunerative rates regular shipments will be made. This timber is very strong (P = 827) and durable, its weight is 55 lbs. to the cubic foot. It has been used for gun carriages both in India and in England; furniture made of it was exhibited in Paris in 1878, and since in the exhibitions in Calcutta, Edinburgh and London, and was greatly admired. Its handsome appearance (equal if not superior to that of mahogany) makes it a suitable wood for furniture, fittings of railway carriages and ships' saloons, and for carriage building, while its great strength and durability recommend it for all constructive purposes, where first class timber is necessary.

V. Notes, Queries and Extracts.

A NEGLECTED DUTY OF GOVERNMENT.—We spoke in a recent article of the Indian theory of Government as it has always been understood by the rulers and the ruled in this country, as in all Oriental countries. Starting from the principle that the soil belongs primarily to the State, this theory requires that the people should use it in the interests of the State as well as their own, and assumes that State and people area like interested in its improvement. As regards cultivation we have before said that it is the duty of Government to insist upon the people doing their share of the improvement of the land, towards which the Government has done, and is doing, so much. Our present concern is with the waste, and especially with that portion of the waste which was once, and might be again, covered with valuable forest.

To speak first of village common in the plains. On this common depend to a great extent the village cattle. Cultivated fodder is fed to plough-bullocks and to cows in milk ; but the breeding cattle depend for sustenance mainly on the wild pasture. Restriction of this and consequent decrease of cattle, means diminution of supply of young stock, enhancement of the price of bullocks, decreased supply of manure, and consequent increased cost and diminished efficiency of agricultural operations. These are matters in which the Government is much concerned : its interests are affected, and it becomes its duty to interfere. On its own part Government is doing all it can, by promoting cattle fairs, by breeding bulls, by creating fodder reserves and experimenting in the cultivation and storage of fodder, to improve the cattle supply. In the common interest, therefore, the people should be encouraged, assisted and directed in doing the same ; and, if necessary, compulsion should be put upon them to do their share towards advancement of agriculture by protecting and improving the waste land for the support of cattle.

To this end we should—strictly in accordance with the native theory of good administration and of the relations of the Government and the people respectively to the soil—debar any breaking

up of waste land without permission. We should prescribe the reservation and improvement of portions of the village area as fuel and fodder reserves, for village use under certain regulations, and we should exercise the necessary supervision to enforce these regulations being carried out.

But there are parts of the country where the short-sighted folly of the people, and the neglect of the Government, have produced evils infinitely greater than merely restriction of pasture, decrease of supply of agricultural cattle, and consequent deterioration of agriculture. Hill-sides, intended by nature to be clothed with forest or bush, have been not only cleared but stubbed—not only stubbed—but indiscriminately grazed down, to the prevention of all possibility of reproduction. The results are far-reaching and lamentable. Deprived of their natural protection the hill-sides have been scoured by rain, all soil being washed off, and nothing left but bare and barren rock. Worse still, the *detritus* of this rock is carried down further and further yearly, to the destruction of fertile land in the plains below. Again, not only have these beneficent springs and streams dried up, which once were maintained by the retaining and filtering action of soil and herbage upon the rain falling on the hill-sides ; but, as these retarding agencies no longer exist, that rain rushes at once off the hill-sides into the ravines, and sweeps down them as raging torrents to work infinite mischief in the plains. What question can there possibly be, in such cases as these, of *claims* to do what is mischievous, of *rights* not only to ruin the common property of themselves and the Government, but, in so doing, to injure the common property of others and the Government? Under any theory of administration, the Government can interfere to make people take such order with their own property as not to injure that of others. But under the Indian theory of the relation of the Government to the soil, which theory has never been abandoned, it is the common property of the Government and the people—or rather, property of the Government in which the people have only a claim of "user"—which is being misused to the detriment of the Government, of the offenders themselves, and of their neighbours.

In such a case the Government is not only entitled but is bound to step in, and to take over the management of the property thus misused. At any rate it can compel the offenders to take such order with that property as shall renew the fertility of the hill-sides, shall reproduce the growth of fuel and fodder once found thereon, shall revive the perished springs and brooks, shall restore the *régime* of the streams, and reduce them from destructive torrents

to beneficent floods, and shall thus do away with the evil of sterilising deposits spread over the plains by these torrents. And where the hill-sides were clothed with valuable forests this argument applies with redoubled force. That the forests belong to the Government, is a matter regarding which there has never been any question. In some places the Government has thought fit expressly to give away its property, but where this has not been done it would occur to no one to advance any claim to the forest beyond that of certain privileges, to be allowed in so far as they are not detrimental to the forests.

But unfortunately the encroachment of the people, and the negligence of the authorities has permitted a state of things to arise which is most prejudicial to the forests. Not only are the fallen leaves carried away for manure, but the trees, however immature, are lopped from bottom to top for the same purpose, and thus deprived of the means which nature gives them whereby to breathe and feed and grow. Again the forest is grazed without respite or discrimination, by herds not only of horned cattle, but of sheep and goats. The mischief done by the close grazing of both these latter is notorious, and the goat, moreover, gnaws everywhere and nothing comes amiss to it; even the horned cattle do much harm in their search for herbage. As was said recently at a convention in Ontario:—"If we give the cattle permission to roam amongst the trees, eating and trampling under foot the rejuvenators of the woods, breaking with horn and hoof the rising sapling, tramping the soil from the roots of the trees, and letting in the drying winds—sooner or later our forests becomes but the dried up remains of former greatness." In the same convention, composed mainly of practical farmers, strong remarks were also made, which should be taken to heart by those who see no objection to allowing the zemindar in the plains to bring every inch of bush land under cultivation. It is found that where the bush in Canada has been too extensively cleared away, "the soil has ceased to be so productive, the little streams and rivulets have dried up, greater extremes of heat and cold are experienced, and the climate becomes more variable. * * Again, we find it much more difficult to raise some of our principal crops. The pasture becomes bare and withered in early summer, owing largely to exposure, and to the hot dry winds which sweep along unchecked, and lick up the moisture from the parched soil."

As regards forest land in the hills, much has been done, and is being done, by the British Government, to protect the State property in the interests of both the Government and of the people. But

unfortunately a very large proportion of such land in the Himalaya is in the territory of subordinate governments, where not only is the zemindar not restrained from doing mischief, but the Government itself is foremost in the destruction of the property of the State. The notable case which has recently occurred in Garhwal is one of many; indeed we may apply to most Hill Chiefs the remarks which the Commissioner of Agriculture in the United States made, in 1885, regarding the lumberman :—"The farmer, having a portion of his farm only covered with trees, will almost naturally be prudent in the consumption of them, and can easily be led to see that to sweep them off at once would be to lessen the amount and injure the quality of all the crops of his cultivated field, and that in the end he would be a loser. But the lumberman is open to no such considerations. He sees in the trees, or thinks he does, so much money, and he aims to secure it by the most rapid means. The same is true of the miner. The lumberman and the miner alike cut with reckless profusion, wasting often more than they directly consume, leaving upon the ground large portions of what they cut, and breaking down and destroying much of the young wood in getting what they seek. After this the waste and broken down wood, becoming dry, is ignited by some accidental cause, and becomes the occasion of a raging uncontrollable fire, which sweeps through the forest, carrying destruction over a wide space."

Now these protected Chiefs exist by our favour, and they reign under condition of good government. To injure the State property and prejudice the interests of their own population in the way described is not good government, but actual misgovernment; moreover, they do not injure merely themselves and their people, but also their neighbours. From the clearance of their hill-sides arise all the evil consequences to the plains below which have been described as arising from the clearance of hill-sides in the British territory. Therefore the British Government is bound to interfere and to induce or compel these Chiefs to take the same measure for the protection of their forests which the Government is taking for the preservation of forests within its own territories. In the Native States, as in British districts, in the mountain, as in the plain, the right of the British Government to interfere for the protection and improvement of property held by the State for the benefit of the community, is founded on that law of the Twelve Tables, *Salus populi suprema est lex.* Against this right no private claim or prescription can be set up. There can be no prescriptive right to do mischief or to injure the common weal.—*Civil and Military Gazette.*

THE INSECT PESTS OF INDIA.—The following circular, issued by the Trustees of the Indian Museum, Calcutta, 1st February, 1888, is recommended to the attention of our readers :—

The Trustees of the Indian Museum have had under their consideration the means whereby a useful scientific examination of the insect-pests of India can be best effected. Bearing in view the great economical importance of the investigation, they have directed the first assistant, Mr. E. C. Cotes, to consider it an essential portion of his duties, and have instructed him to communicate with those interested in the subject, and those likely to aid its object, in order to ascertain the facts and collect the materials which must form the basis of all really scientific work of permanent value.

Mr. Cotes will gradually record the entire life-histories and practical methods of dealing with the principal insect-pests, publishing from time to time, as materials accumulate, the information collected, and distributing it to those interested.

It is only by the active co-operation of those who live in the districts where the insects occur, and who have actual experience of the pests, that really useful results are to be expected in this undertaking; but if all will contribute what is brought to their own knowledge of the subject, there will be no considerable difficulty in collecting complete and reliable accounts of the various pests, and hence of arriving at the most suitable methods of dealing with them.

With regard to the value of such enquiries, it is only necessary to point to the success that has attended similar work carried on by Miss Ormerod in England, and by the Entomological Commission under Dr. Riley in America, where considerable advance has been made within the last few years in methods of combating insect-pests, and in diffusing reliable information about them.

The following are the principal points upon which information is wanted :—

1. The occurrence of a pest.
2. Details of the crop attacked.
3. The extent and nature of the damage done.
4. Estimate, where easily procurable, of the pecuniary loss occasioned by the pest.
5. General particulars of the pest and its method of attack.
6. The *egg* of the pest :—
   - *a.* Description of the egg.
   - *b.* Where deposited.
   - *c.* Time taken to hatch.

d. Period of the year during which eggs are found.
e. Measures taken to destroy the egg.
f. Ichneumonidæ and other natural enemies to the egg.

7. The *larva* of the pest (grub or caterpillar) :—
   a. Description of the larva.
   b. Habits and localities selected.
   c. Food plants other than the crop attacked.
   d. Number of moults.
   e. Period of the year during which larvæ are found.
   f. Time taken to complete larval growth.
   g. Measures taken to destroy the larvæ.
   h. Natural enemies, especially birds, ichneumonid and tachinid parasites, predacious insects, and fungoid diseases.

8. The *pupa* of the pest (chrysalis or cocoon) :—
   a. Description of the pupa.
   b. Exact locality selected for pupating (whether on the food plant, underground, or elsewhere).
   c. Period of the year during which pupæ are found.
   d. Time passed in the pupal state.
   e. Measures taken to destroy pupæ.
   f. Natural enemies and parasites.

9. The *imago*, or perfect insect :—
   a. Description of both the male and the female.
   b. General habits.
   c. Localities frequented.
   d. Food.
   e. Date when copulation takes place.
   f. Period of the year during which imagos are found.
   g. Date and method of oviposition.
   h. Measures taken to destroy the imago.
   i. Natural enemies, diseases, and parasites.

10. Alternation of generation, dimorphism, parthenogenesis, and any other points connected with the natural history of the species.

11. Other measures actually adopted for prevention, cure, their cost and effect.

12. Insecticides, especially such as contain kerosine or compounds of arsenic.

13. The history of damage done in former years, with supposed causes of immunity from attack at one time and undue multiplication of the pest at another.

14. The introduction of the pest, the supposed date of its occurrence, and the way it was introduced.

15. The spread of the pest, its direction and pace.

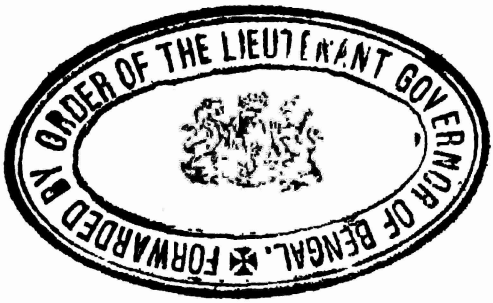
16. The effect of varying soil, moisture, temperature, and other natural conditions, on the pest.

Special attention should be directed to the positions selected for oviposition, pupating, and hybernating, the state (whether as egg, larva, pupa, or imago) in which the insect hybernates, the number of generations in the year, and the food plants other than the crop actually attacked, as on these preventive measures can frequently be based.

Individual observation will of course often be confined to single points in the life-history of each pest, but if these are jotted down and forwarded as they present themselves, they will frequently be of value as filling up what would otherwise be gaps in the history of the pest. The complete history may take some time to record, but when once the main facts are known about each pest, it will be easy to specify the exact information wanted to complete the record.

Each pest should be dealt with entirely separately; and observations should, in all cases, be accompanied with specimens illustrating, as far as possible, the pest and its method of attack. Specimens of the pest itself should be sent, where possible, in all stages of development and in considerable numbers; eggs, caterpillars, and other soft-bodied insects in strong alcohol or spirits of wine; chrysalids or cocoons alive and packed lightly in leaves or grass; other insects dried and pinned or wrapped in soft paper. Live insects are always preferable to dead ones, and should, in all cases, be sent where there seems to be a reasonable probability of their surviving the journey. Specimens of leaves and green plants damaged by the pest may be sent wrapped in damp cloth, grain, wood and such like being packed as occasions suggest.

Observations on economic insects should be written clearly on one side only of the paper, and sent with the specimens to Mr. E. C. Cotes, Indian Museum, Calcutta; they will be gratefully received, in all cases, acknowledged, and, so far as possible, any information about them will be given, or sought for from experts in Europe and America.



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CHANGES AT THE NANCY FOREST SCHOOL.

MANY of our readers will be interested to hear that by a Presidential decree, dated January 9th, 1888, it has been settled that the students of the National Forest School at Nancy shall all in future be recruited from among the passed students of either the 'Ecole polytechnique' or the 'Institut national agronomique.' We hear that the measure has caused some dissatisfaction in the Forest service in France, but it seems to us that the step is decidedly one in the right direction, and likely to be to the benefit of the service. It is probable, however, that most of the dissatisfaction is due to the fact that the number of students has been decreased, that is, that instead of 18 to 20 in each 'promotion' as formerly, there will now only be 12. It may be presumed that the chief object in this change is to give more chances of promotion from the lower ranks than hitherto, thereby encouraging a better standard of knowledge and to improve the class of students at the "Ecole des Barres," whose numbers, by the way, are also reduced, by the same decree from 14 to 6.

It has always been customary, since 1873, to admit, without competition, to the Forest School, any passed students of the 'Ecole polytechnique' who have not been able to be provided for in the other services to which the education at that institution leads, *i.e.*, the Mines, Public Works, Military Engineers, &c. And, since 1882, two students of the 'Institut agronomique,' who have fulfilled certain conditions, have also been yearly admitted in a similar way.

The result of the new rule will be, it seems to us, that the educational qualifications of the forest students will, in future, be greatly improved, and that, instead of a number of men selected by

competition after a more or less speedily crammed examination, they will be all men who have been previously thoroughly well grounded in the subjects upon which scientific forestry is based. As the course of instruction at the 'Institut agronomique' is a 2-years' one, and that at the Forest School of a similar length, the whole course in future will really be a 4-years' one, and the students should, on its expiry, enter on their duties with much the same thorough training as do the Forest officers in the chief services in Germany. If we mistake not, the course of study in Bavaria comprises two years at Aschaffenburg and then two years at the University at Munich.

To show what the training at the 'Institut agronomique' consists of, we cannot do better than quote the following extract from the "St. James' Gazette" for February 6th :—

"The Institute was founded in 1848 at Versailles, with 3,500 acres of land attached to it, and such professors of agriculture as the Comte de Gasparin, M. Léonce de Lavergne, M. Becquerel, &c., to teach in it. But one of the first acts of Napoleon III., after he had been proclaimed Emperor, was to suppress the institute; the reason assigned being that it was a nest of Republicans and Orleanists, though the real reason seems to have been that he wanted the land for shooting purposes. No more was heard of the Agronomical Institute until about ten years ago, when M. Teisserenc de Bort, a Minister of Agriculture who had a practical knowledge of farming, induced his colleagues to sanction its revival. It was resolved that the Institute should this time be in Paris itself, where all the best laboratories, libraries, and zoological collections are to be found; but, at the same time, arrangements were made for the formation of an experimental farm at Joinville-le-Pont, close to Vincennes; so that students might be able to gather something of the practice as well as of the theory of agriculture. Owing to the embarrassed condition of the Treasury, the Ministry of Agriculture has not yet been able to obtain the large sum of money (about £40,000) necessary for the erection of a building suitable for this establishment, which is temporarily lodged at the Conservatoire des Arts et Métiers. The Institute does not take any resident students, the arrangement being that they should attend lectures daily for the period of two years over which the education extends. The course takes a very wide range: embracing mineralogy, meteorology, general chemistry, geology, anatomy, botany in every form, land-surveying, construction of machinery, and other subjects which are likely to be useful to men who are destined to become professors of agriculture, agricultural chemists, land-surveyors, and so forth. More than all, during the vacation—which lasts from the 15th of July to the 31st of October —those students whose parents are not agriculturists are sent at the expense of the Institute to reside upon some farm either in France or

abroad, and are expected to bring back with them a full account of what they have seen. This paper is taken into the reckoning when their work is examined at the end of their two years' term with a view to ascertaining whether they are entitled to the degree of "ingénieur-agronome." The conferring of this degree, equivalent to that of Bachelor of Sciences, carries certain advantages with it, such as admission upon easy terms to the School of Forestry, while the holder of such a degree will be pretty certain of employment upon liberal terms. Another good thing about the Agronomical Institute is the excursions which the students make every year, under the guidance of two or three professors, to some interesting district of France or to some important agricultural school or establishment abroad. Here, as in the farm-schools and the three national schools, the cost of education is very small, while there are four scholarships of £40 each and two of £20 each for the benefit of students whose parents cannot afford to pay for the lectures and excursions. At present there are about 60 students, whose average age I should take to be about two-and-twenty. It is hoped, however, that in three or four years' time the maximum (100) will be reached, and perhaps by then the Institute will have a home of its own. But, despite the difficulties which have beset its creation, it is already doing good work for French agriculture."

We may hope before long to hear whether it is intended to make any large alteration in the studies at the Forest School at Nancy, in consequence of the new departure. Much might yet, we think, be done, in order to bring the teaching in France to the same high standard as is achieved by the principal German schools, and notably by the University of Munich. The facilities for scientific study at Nancy have, of late years, been greatly improved by the introduction of more practical work in such subjects as Forest botany, the enlargement of the museums, the provision of admirable models of works, &c., and we shall be surprised if the final effect of the new departure is not, in spite of the conservative head-shakings of the old school, a very important advance in scientific forest teaching in France.

MINERAL DEPOSITS IN WOOD.

At a recent meeting of the Linnean Society of London, Mr. D. Morris, of Kew, exhibited a piece of the wood of a tree, *Hieronyma alchorneoides*, in clefts of which was a hard mineral deposit, said to be carbonate of lime and alumina. He also referred to a note by Sir F. Abel, which was published in the Journal of the Chemical Society for March 1862, on the occurrence of such deposits in

teak wood. In that case the substance which Sir F. Abel had carefully analysed had been found to consist of phosphate of lime with a small quantity of ammonio-phosphate of magnesia. The analysis gave the following percentage results :—

Lime, ...	34·04
Magnesia, ...	1·86
Ammonia, ...	1·12
Phosphoric acid, ...	43·35
Water and a small proportion of organic matter, ..	19·54
Carbonic acid, ...	·09
	100

In some analyses of wood ashes which was made in India in 1884, by Dr. H. Warth, the Professor of Chemistry to the Forest School at Dehra Dun, the proportion of phosphates in teak wood was found to be very small.

Dr. Warth had ascertained that in 100 lbs. of steam dry teak wood there was 0·77 lbs. of ash, of which the following was the composition :—

		or per cent.
Soluble potassium and sodium compounds, ...	0·13	16·88
Calcium carbonate, phosphates of iron, calcium, &c., ...	0·31	40·26
Magnesium carbonate, ...	0·21	27·28
Silica, &c., ...	0·12	15·58
	0·77	100

We may compare with these figures, those obtained by Mr. R. Romanis, D. Sc., Chemical Examiner to Government at Rangoon, and published in a paper in the 'Indian Forester' for February 1886. Mr. Romanis' analyses gave for teak heart-wood the following :—

Potash, ...	1·51
Soda, ...	2·82
Lime, ...	11·80
Magnesia, ...	21·97
Oxide of iron, ...	1·79
Phosphoric acid, ...	27·42
Silicic acid, ...	32·69
	100

a result which it is not easy to compare with that given by Dr.

Warth. Both, however, seem to agree in showing that magnesia is the principal component, and their results do not seem to clash with those of Prof. Abel for the composition of the deposit.

In 1878 some white deposit found in clefts of blackwood (*Dalbergia latifolia*) by the writer was analysed, and the result showed that it consisted chiefly of carbonates of lime and magnesia. It is to be regretted that the details of the analysis were lost. We have no information regarding the composition of blackwood either from Mr. Romanis or from Dr. Warth, but the latter's analysis of the very similar wood of the sissu (*Dalbergia sissoo*) gave 1·17 per cent. of mineral ash, of which nearly one-half, or 0·57, was carbonate of lime or magnesia.

Mr. Christy, who was present at the meeting referred to, stated that such deposits were rare in Burma wood, though common enough in teak grown in the Peninsula. It is possible that in this he is right, and that the wood grown in the more regular climate of Burma is less liable to get split or develop hollows than that grown in parts of India where the seasons show a more marked difference, still it would be interesting, if any of the readers of this Journal could supply some information on the subject. He further said, as did Prof. Abel in the paper referred to, that the deposits were often so large and so hard that the axe-men and sawyers refused to work on the logs which contained them, as the deposit damaged their tools. The writer does not remember that he has ever heard of any such case in his experience.

Deposits of mineral matter occur frequently enough in some woods besides teak. They may often be seen in that of *Dalbergia latifolia* usually in radial clefts like star-shakes, and often of considerable amount. They may be seen in sissu, in *Terminalia tomentosa*, in most of the ebonies, in *Dillenia pentagyna*, and possibly in other trees. Could some of the readers of this Journal, who may come across such things, get them analysed, so that we may know definitely what is the usual composition of the deposits in the different species, and at the same time ascertain something of their origin. Besides these comparatively large masses of mineral matter which occur in the clefts of a log, there are also somewhat similar deposits in the vessels of different species. Every one knows the curious white deposit which fills the pores of the wood of the *Strychnos Nux-Vomica* and *Strychnos potatorum;* the yellow ones in that of the species of *Stereospermum* and *Pajanelia*, and doubtless others will suggest themselves. Then there is the peculiar deposit found in bamboos, and called 'Tabasheer.' It is most common in the thorny bamboo or 'kattang' (*Bambusa arundinacea*) and the 'Moolee' of

Chittagong (*Meleranna bambusoides*), and consists of silicates of lime and potash. The whole question of Tabasheer was lately discussed by Mr. Thiselton Dyer in the pages of 'Nature,' and by Sir D. Brandis in the 'Indian Forester' for March 1887, but there is still some doubt of its real cause.

Mr. Morris also showed a 'cocoanut pearl,' a very curious and heavy pearl-like substance of about the size and shape of a hedge-sparrow's egg. This is a very rare product, and is, it is understood, much prized as a talisman by natives in the Islands of the Eastern Archipelago who find it. That belonging to the Kew Museum, presented by Dr. Hickson, is said to be one of the first that has reached England. It is found in the interior of old nuts, and consists of carbonate of lime almost pure, a section of the pearl showing hardly any structure at all.

How it is produced, and how it is valued, and for what, is a problem for those officers who in Malabar or Burma or elsewhere, have it in their power to make enquiries from the growers of cocoanut trees.

KEW,
18th February, 1888.

J. S. GAMBLE.

TREATMENT OF BAMBOOS.

IT was an evil hour when I undertook to write on the reproduction and management of bamboos, little thinking at the time that I would be taken to task so severely by one of our highest authorities, in the person of Mr. Gamble. I had only hoped by my proposals to be favoured with a definite set of rules on the subject, as I said before that I was only a beginner. However, to the best of my recollection and abilities I submit the following answers, though it must not be forgotten that every rule has an exception.

Answer 1. "25" is the number stated by Mr. Gamble as arbitrarily assumed by me; which is quite correct, as I have no record to produce on this head, nor of the age 7 years. As I was not in the Forest Department my observations were not noted in any book. There may be 30 or 40 culms per clump at this stage of the age of planted bamboos, but it must be taken into consideration that the ones planted have many advantages over those growing wild in a forest. Mr. Gamble says some bamboos were planted at Bamunpokri, and in 5 years they were of workable size. What was the average number per clump then, should be known? I do not think there can be at the present day more than 50 to 60 bamboos per average clump. So to be on the safe side, and as the cuttings are

in the forest and not in a plantation, I said 25, when the clumps are about 7 years old.

With regard to species, I beg to say that I do not know the scientific name; we call it Bhalka or Bara Bans [illegible] Lower Bengal (Jessore and Hazáribágh). I have not ta[illegible] any particular note, as I said before I was not in the Forest De[illegible]ment, and did not at the time think it necessary to note the [illegible]ual shoots, but this much I must say, that when new stems are [illegible]thrown up from the rhizome of a planted bamboo off-shoot, for the first year only one appears, or at the utmost two, and in *no* case more than [illegible] number with no greater size than 2 to 2½ inches in girth at [illegible] feet from the ground: the parent of this shoot may have been [illegible] to 10 inches in circumference. The second year, three or four more of about 5 or 6 inches; the third year, the culms are six or seven in number, with a girth of 7 or 8 inches, or even the size of the planted mother stool. Then on the 5th year how many would be fit for cutting? Hence, I said 7 years would be about the best time, considering we have to deal with forest growth.

BENGAL SECRETARIAT LIBRARY

Answer 2.—Eight bamboos being the average growth per clump per year, not of planted but of wild forest bamboos, (those planted would give much more, as I have said in my 7th proposition in December Number,) of an average clump containing 25 culms. Here again to be on the safe side, I said to cut eight bamboos yearly, though it would scarcely be concluded that all the clumps in the forest were comprised of 25 culms, and that they only throw up eight shoots yearly. To argue a thing for the sake of argument is one thing, but if one had to examine the forests in Palamow, it would be found that the average growth per clump would come to about eight culms annually, and instead of closing the block for a time, one may go on cutting indefinitely eight every year, so long as a clump of 25 bamboos produces an average annual growth of eight culms, as I have already said in my proposition 3, which I here give for ready reference. "Thus, clumps forming 25 to 30 culms can bear removal of eight to ten bamboos annually with advantage, and above this number, average growth *per clump per year must first* be estimated." Now the object of my saying 7 inches in girth is to safe-guard a younger clump which may have got 25 bamboos, but has not attained the full size, such as are found in Chuttra and Kunda in the Hazáribágh district, in the Eastern Siwaliks between Hardwar and Dholkand in the Saháranpur Forest Division, N.-W. Provinces, and Bettah, Saidope and Ramandag ranges in the Palamow Forest Sub-Division, Chota Nagpur.

Answer 3.—The clumps of Bettah, Ramandag and Saidope ranges in the Palamow Forest Sub-Division yield at an average per clump per year eight culms as stated above.

Answer 4.—My object was to leave 2½ feet, and as the coolies in Palamow did not understand this well, I mentioned three nodes, which is as close as one could expect for 2½ feet, and my reason was chiefly "reproduction." Every one knows that cutting flush to the ground means weakening the rhizome, which, if continued, means death at last; on the contrary, high cutting does not dry up the stool for a long time, but low cutting does, and very soon too. I may here as well add by way of proof, that when one plants out bamboos the off-shoots are 4 to 5, or even 6 feet long—why? To ensure living of course, and on this I hold that high cutting is beneficial to reproduction, and I believe for this very reason too those planted in Bamunpokri during 1877-78, if I mistake not, were about 4 or 5 feet long.

Answer 5.—My reason is as I have stated, with this addition, that when I said cutting immature shoots kills the clump, I did not mean to say in one generation, certainly not, but in two or three, or more; though death is eventually certain. Sir D. Brandis says that it weakens the rhizome; it then throws out for a series of years only thin stems. Now if these thin stems are cut down as they come up, what follows? Weakness and death at last. So my object in saying nothing under 7 inches in girth should be cut, is to be on the safe side.

Answer 6.—The reason for the removal of dry culms is, as Mr. Gamble has already said, merely to help regeneration. Should the dry stools be left, insects appear which not only devour the rotten bamboo, but very often eats up the germ of the rhizome, for which I have seen natives of Lower Bengal fire their bamboo clumps annually, in the belief that it not only kills all destroying agents, but helps to hasten plentiful reproduction. This idea may be wrong, but burnt earth with leaves and dry bamboo ashes makes capital manure, and should assist reproduction.

Answer 7.—I must repeat that what I have said, I have seen without taking any particular notice, or recording the result of any experiment. I saw the treatment of bamboos as practised by natives in Jessore and Hazáribágh, and hence suggested those seven propositions, hoping to be put right, where I may have been wrong.

One point more I wish to bring forward with regard to cutting of young shoots for basket making, &c. I should think it was the Tulda bamboo which is used for this purpose, and not Bhalka, and

the cutting of these young shoots may be avoided if the bamboos are cut and dried for eight or ten days in the sun ; then kept under water, or, better still, in clay, for about a fortnight or so, when they become as pliable as shoots five or six months old.

CAMP GOSHEHAT,
27th March, 1888.

J. C. MENDES.

MEMORANDUM ON DATE CULTURE,

SUBMITTED TO THE MEETING HELD AT JEYPUR IN CONNECTION WITH FLOWER SHOW HELD ON 10TH MARCH, 1888.

ON the suggestions of Government that dates are useful trees in times of famine for the poor people to live upon their fruits, the State Council of Jeypur desired to have some experiments in this locality. Brigade Surgeon E. Bonavia, who has studied its culture, and who reared several date trees at Lucknow for Government, was addressed on the subject. He replied that its culture in Jeypur was not only desirable, but useful and possible, as the dry and sandy soils of Rájputána were suitable for its introduction. His letter was considered interesting and instructive. It was therefore published and distributed to some of the nobles and officials of the State for general information.

The Forest officer was deputed to Lucknow and Saháranpur, to inspect dates cultivated in those places. On his return he drew out certain instructions, which were published in vernacular, and distributed for general information. Mr. J. F. Duthie, B.A., Director of Botanical Department of Upper India, supplied some 24 maunds of Tunisian date stones in the last year. They were tried by several gentlemen and officials :—

About three maunds of date stones were sown in Ram Newas' garden, and some 7,000 seedlings were, as an experiment, transplanted at Amanishah, Bhakhri and Kalegh Sagar Bunds after three months. Unfortunately there was unusually heavy rain last year, hence a considerable number of seedlings died, but some of them however, survived, and are doing well. Some of the gentlemen who tried date stones write as follows :—

Thakúr Sawant Singh of Bagru writes—that he sowed about two maunds of date stones. Some 4,000 seedlings germinated, but on account of the heavy rains, most of them died. He has still some 1,700 seedlings in his estates. Each of these seedlings had in last October three or four leaves.

Thakúr Hari Singh of Shekhawat writes—that he cultivated dates in Haripur, Kheri, and Taradu of Shekhawati in the month of July. The soil at Kheri is saline, and the water in wells in Taradu is deep, being about 60 feet below the surface. He has in these three villages some 1,400 plants, which are doing well, specially at Taradu, which is otherwise destitute of all kinds of trees. The plants, he adds, are about a foot high, and have five or six leaves on them, except in hilly places, where they have only about two, and the height of plants is also less. They are watered twice a week.

The Rev. G. Maclister, M.A., says—"I have much pleasure in saying that I sowed the date seeds and that most of them germinated. I sowed them in two beds, there are nearly 200 altogether. I transplanted about half a dozen of them, putting them about 4 yards apart; three of these are alive and vigorous. I also planted one in a large box, and it is now the largest and finest plant I have. I also planted five in flower pots, and these are all alive and doing well. I hope to transplant all those that are still in the beds, at the proper time, and I am glad to be able to express the hope that so far as I can see there is every likelihood of their doing well."

Rám Nath Singh, Head Master of Noble School, Jeypur, says—that he has about 500 seedlings in his village in Shekhawati; they are doing well, and have each of them some five or six leaves. The soil is sandy and contains some manure, and the plants are watered twice a week.

The Superintendent of Baghat writes—that the date stones sown by him germinated fairly and are doing well. They have got some two or three leaves on each plant.

Babu Sukh Lál and Munni Lál of the Engineering Department state—that they have got some 3,635 plants on different bunds under their charge.

The date stones sown at Bhat ka Bagh, Amanishah and Madhopur, as well as in the Forest office compounds by the Forest Department, germinated freely, and are doing well. They were sown in July in small beds, and irrigated twice a week. They had a good start at the outset and are about a foot in height. The soil is sandy, free, but poor. They have now about their fourth leaf out, though some vigorous ones have got their sixth. They are altogether in number 3,500.

To encourage date culture in this State, the Council, on the recommendations of Lt.-Col. S. S. Jacob, Executive Engineer, sanctioned the award of prizes at the rate of 6 pies per plant per annum

to those cultivators who would try them in Crown lands. The Irrigation Muhafizan (*i.e.*, Sepoys) are also eligible for such prizes. The officers of the State, who would take special interest in the encouragement of its cultivation, will be given certificates by the Durbar.

SADHU SINGH,
Forest Ranger.

RHYNCHOTA OF INDIA.

I HAVE undertaken for the Asiatic Society's Journal, a catalogue with descriptions of the *Rhynchota* of India, and would ask your co-operation in procuring specimens, of which duplicates will eventually be deposited in the Indian Museum. I shall be ready either to make exchanges of this or other orders, or name collections, so far as the materials at my disposal will allow. The order *Rhynchota* is of considerable economical and physiological importance, and to render the catalogue of permanent value, I would ask the co-operation of workers in other branches of Natural History to collect and furnish specimens that will enable me to adequately set forth our Indian fauna which is particularly rich in this order. The species will be readily recognized by the presence of a proboscis or beak either porrect between the antennæ, or curved, or resting quiescent on the sternum beneath. Some resemble butterflies and moths, others are like beetles, and many emit a strong aroma when alarmed. I would ask that where possible the month of capture be added to the locality, as it is desirous to accumulate data as to appearance.

Mr. W. L. Distant is preparing for the Trustees of the Museum a monograph of the *Cicadidæ*, belonging to this group, and so well known for the shrill cry of the male on trees in the rains. This will be illustrated by figures of each species, and it is desirable that as many species as possible should be procured so as to make it tolerably complete; any sent to me to the undermentioned address, or direct to Mr. Distant, at 1, Russell Hill Road, Purley, Surrey, will be thankfully acknowledged. For catching these insects, the ordinary net may be used, and for killing them the poison-bottle. A Keating's lozenge bottle is found useful, in which place a mixture of one part of cyanide of potassium and eight parts or thereabouts of plaster of Paris, gumming a piece of paper over the mixture to retain it at the bottom. About half an inch of this mixture will remain efficient for a long period. Another way is to place the

captures simply in spirits of wine, but the first plan is more effectual for the larger species. The insects can then be pinned in boxes or simply kept in spirits of wine, and can be sent by parcel post in thin wooden boxes or old biscuit tins packed in paper, leaves, or moss, in layers. These boxes may be sent bearing to the undermentioned address. Any further information required I shall be happy to furnish so far as I can.

E. T. ATKINSON.

18, STORE ROAD, BALLYGUNJ,
CALCUTTA,
2nd February, 1888.

P.S.—Mr. de Nicéville would be glad to correspond with collectors of Butterflies.

14-1 SUDDER STREET, CALCUTTA,
17th February, 1888.

Vol. III. of "the Butterflies of India" is in active preparation.

MEMORIAL OF THE CORPORATION OF SOUTHAMPTON.

THE Memorial of the Corporation of Southampton, which it is hoped will have the co-operation of most of the other local bodies in Hampshire, has recently been sent to the Lord President of Her Majesty's Privy Council. This sets forth—

1*st.* That your Memorialists are much interested in the general subject of Practical and Scientific Forestry, in the preservation and greater utilization of the Crown forests, in general improvements in the methods of growth of timber and underwood, and in the acclimatisation in England of foreign trees of economic value.

2*nd.* That your Memorialists have heard with much interest of the proposed establishment of a National School of Forestry for England, at which Indian and Colonial pupils in Forestry could also receive instruction.

3*rd.* That the following Crown forests are situated in Hampshire and the Isle of Wight:—

(*a*). The New Forest, comprising about 63,000 acres, by far the most extensive forest in the United Kingdom, of which by Act of Parliament 16,000 acres can at any one time be closed for planting, while the remaining 47,000 acres, on which trees may be growing, are at any one time to be left unclosed.

(*b*). Woolmer Forest, now enclosed and free from Common rights.

(*c*). Alice Holt Forest, now enclosed and free from Common rights.

(*d*). Beer Forest „ „ „ „

(*e*). Parkhurst Forest „ „ „ „

There are also Harewood, Pamber, Stanstead and other extensive forest lands in private hands.

4th. That these Crown Forests are situated on the following geological formations:—Lower greensand, gault, Upper greensand, chalk, Reading beds, London clay, Lower Bagshot, Bracklesham and Upper Bagshot beds, Barton clay, Headon beds, Hempstead beds, drift, gravel, alluvium and bog, and that consequently they contain almost every variety of soil for timber growth, and upon selected areas of which experimental plantations with a view to the acclimatisation of suitable foreign trees of economic value and adapted for special soils might be easily carried out.

5th. That large areas of the New Forest are especially in want of scientific Forestry, the trees in many parts of the forest being rapidly decaying, owing to the restrictions applied by existing Acts of Parliament.

6th. That the climatic advantages of the forest parts of this country make it admirably adapted for the growth of timber and for a great variety of work in practical Forestry.

The prayer of the Memorial is therefore that the proposed National School of Forestry may be located in Hampshire.

St. Andrews, Scotland. GEORGE CADELL.

BOARD OF FORESTRY.

IN view of the Board of Forestry which the Committee of the House of Commons recommended should be established in Great Britain, and the probable functions which it will be called upon to fulfil, it is interesting to notice the various views expressed regarding its probable usefulness by the writers of the annual reports of the position and prospects of the landed interest in the various counties of England.

Thus the report on Gloucestershire states—

"There has been no planting of forests or trees to any extent about here for the last 17 or 18 years, and there is scarcely any part of an estate in this neighbourhood and others where the woods are not neglected. The subject does not appear to be understood. There are doubtless

hundreds of acres of inferior land at the present time totally unfit for any other purpose except planting, and which would by judicious management amply repay the owner in years to come. The proposed School of Forestry, if properly conducted in a practical manner, would undoubtedly be of much benefit, and it would be the means of arousing the attention of owners to this important subject."

In South Devon it is considered that the School of Forestry will meet a want which has long been felt, and that not only woodlands may be made more remunerative, but that paying crops of timber may be raised on lands which are not now cultivated.

The writer on East Sussex finds the rates and taxes an insurmountable burden on the profitable growing of wood. The copse wood in that district is cut every 10 or 12 years, and in the present state of depression realizes not more than £5 an acre, while the rent, rates and taxes are placed at not less than 12 shillings an acre.

In Herefordshire the "woods are as a rule left to manage themselves," a species of "home rule" which does not appear to be very satisfactory. While in counties bordering the sea, Baltic and other timbers are offered at a price far too low to encourage the cultivation of home grown plantations.

St. Andrews, Scotland. GEORGE CADELL.

IMPERIAL FOREST SCHOOL, DEHRA DUN.

THE results of the Final Examinations of the Senior Ranger's Class, which were read out by the Director on the 21st March, were as follows. The names are given in alphabetical order—

Obtained Ranger's Certificate from 19th March.

Hanumantha Rao,	Northern Circle, Madras.
Madho Pershad,	School Circle, N.-W. Provinces.
Malaya Pillai,	Southern Circle, Madras.
I. G. F. Marshall,	" " "
Nagraju,	" " "
Pandurang Narain,	Berar.
Saldanha,	Southern Circle, Madras.
Shoradindo Gosami,	Assam.
G. H. Wittenbaker,	Berár.

Obtained Forester's Certificate.

Nikunja Behari Nandi,	Bengal.
Eggya N. Shastri,	Southern Circle, Madras.

Vernacular Class, Forester's Certificate.

Badri Datt,	Central Circle, N.-W. Provinces.
Gaja Dhár,	„ „ „ „
Hans Ráj,	Private Student.
Jagbandhan Singh,	Rewah State.
Madho Rám,	School Circle, N.-W. Provinces.
Manwar Singh,	Central Circle, „ „
Natha Singh,	Punjab.
Randaman Singh,	Rewah State.
Sheikh Chand,	Central Provinces.
Jot Rám,	Central Circle, N.-W. Provinces.

These Certificates date from 15th December, 1887.

Rastamji,	Pertábgarh State, on 23rd March, 1887.

EDIBLE LICHENS.

In August 1886, Mr. Brougham, Assistant Conservator of Forests at Bellary, drew attention to a lichen called in Telugu 'Ratha pu' or 'rock flower,' which is used as food by the inhabitants of that hot district and considered to be a delicacy. It has been submitted for identification to the authorities at Kew, who pronounce it to be a species of *Parmelia* near *perforata*, Ach. Lichens are often used as food in time of scarcity in North Europe, but it is interesting to find a case of the kind in India. Can your readers call to mind any other cases?

J. S. G.

ORGANIC CHEMISTRY AT COOPER'S HILL.

We hear that Viscount Cross has sanctioned the annual expenditure of £105 in order to afford the Forest students suitable instruction in Organic Chemistry, and in a Note by the Under-Secretary of State on the subject of Forest education at Cooper's Hill, we read with pleasure that in every other respect the course of studies seems to have been of a nature to fit the young men who pass out from the College for the duties they will have to perform when appointed to the service in India. This gratifying result is due in large measure to the care which Sir A. Taylor has devoted in the supervision of the new arrangements, and to the intelligent industry with which Dr. Schlich has performed the functions entrusted to him.

II. Reviews.

FORESTRY IN THE UNITED STATES.*

We have before us the report of Mr. B. E. Fernow, the Chief of the Forestry Division, Department of Agriculture, in the United States, for the year 1886, and from its perusal we cannot find that any practical steps have yet been taken to conserve the proportion of forest area necessary for the future existence of that great country.

The Statesmen of America have yet to learn that the *laisser faire* forest policy, which may not have disastrous effects in islands like those of the United Kingdom, where there is an assured and equably distributed rainfall, a mild climate, and certain supplies of sea-borne timber, cannot be long followed with impunity in a continent.

The lesson is anticipated by Mr. Fernow in the following sentences:—

"While—thanks to our more favorable conditions of configuration and our less closely worked soil—we are by no means anywhere near such conditions of devastation as those experienced by Southern France, Switzerland, and the Tyrol, where, to preserve the agricultural lands below from devastation by water, many million dollars have been expended and are still expended yearly, for the costly building of dams and for difficult reforestation, yet such conditions are merely dependent upon time and continued negligence; and we had better decide now whether the policy of unconcern shall be abandoned, and whether by simple protection and preservation of the existing forest cover great loss and the expenditure of millions in the future shall be saved to the nation. That such important interests may safely be intrusted to the care of the private

*Annual Report of the Divisions of Forestry for 1886. By B. E. Furnow, Chief of Division: Washington—Government Printing Office, 1887.

individual, whose life is short and whose concern is for to-day, nobody can reasonably assert. That such use of the forest can be secured only if kept in the hands of the whole nation (*i. e.*, the General Government or the individual State Governments) lies in the nature of things, as the State alone will be found capable of managing a large property for other purposes than to realize its direct money value. The objection of expense raised against such measures as have been proposed for the preservation and protection of Government timber lands is frivolous in view of the magnitude of the interests at stake, and the practicability of organizing a service to prevent spoliation of these forests and to manage them as shelter forests in the interest of the regions in which they are situated, may be made apparent by a sketch of such an organization in detail.

Plan for a Forest Department.

"I may be allowed to quote here from a letter recently written by me on this subject at the request of a special agent of the Department of the Interior:

"* * * As preliminary to the discussion of what should be the policy of the General Government, allow me to state a few points of forestry which must be understood:

"(1). Not more than what grows yearly or during certain periods should be cut in a forest which is to be kept in perpetuity.

"(2). No clearing, unless followed by immediate planting, is admissible in mountain forests; nor is it advisable in the plain.

"(3). The cutting of timber must be done with a view of renewal above all other considerations. The method, time, and duration of cutting over a given tract depend upon the kind of timber and the locality. To be continually successful in keeping a desirable forest cover requires more care than the simple method of selection practised by the lumbermen.

"(4). What the average yearly accretion in the forests of the public domain amounts to is still more uncertain than their extent. Assuming that the 70,000,000 acres probably owned by the Government produce yearly, at an average, only 10 cubic feet per acre, which by correct management could in a short time be doubled, and reckoning 1 cent per cubic foot on the stump as a low estimate, the domain at present represents a capital of at least $280,000,000. The annual expenditure for the preservation and improvement of such property of a sum equal to the value represented by the annual growth may not be considered extravagant. To this add the larger part of $8,000,000, the value of timber destroyed by fires, which would probably be prevented by proper or-

ganization.* If, therefore, the importance of these mountain forests did not justify a larger expenditure annually upon their preservation, the application of the value of their annual product for their protection and management would be admissible simply from a business point of view.

"The following features in the organization of the public timber domain appear desirable and practicable :—

"(1). To withdraw from sale or other disposal all timber lands.

"(2). If the expense of a survey—a simple running of outside boundaries—appears too great to warrant such survey, the withdrawal may be gradually effected by a process of exclusion whenever entries for land are made. The exact location, too, may be established gradually from the notes of local land officers and the observations of the forest guards, as hereinafter suggested. But in the more settled districts a boundary survey at least will soon become necessary.

"(3). The organization of the service should include a central bureau, travelling and local inspectors, and forest guards.

"(4). The organization of the forest area should proceed gradually, as required, by dividing it into reserves of 10 to 20,000 acres each, 20 to 30 of such reserves to be formed into a district, the size and number of reserves and districts to be dependent on local needs and the greater or less difficulty of inspection. Unorganized territory to be divided into districts only.

"(5). Functions of officers :

"The rangers, or forest guards, act as local police, under general instructions and regulations from the central bureau, and under direct supervision of local inspectors, to whom they are responsible for their reserves, and upon whose recommendations they should be appointed. Assistants may be required during the dangerous season, and sheriff's power to call upon the aid of any citizen should be conferred upon these.

* The acres burned over and values destroyed during the census year 1880 were reported as follows :—

States and Territories.	Acres	Value. $	States and Territories.	Acres.	Value. $
California, ..	356,895	440,750	Montana, ..	88,020	1,128,000
Washington, ..	37,910	713,200	Idaho, ..	21,000	202,000
Oregon, ..	132,320	593,850	Wyoming, ..	83,780	3,255,000
			Nevada, ..	8,710	19,000
			Utah, ..	42,865	1,042,800
			Colorado, ..	113,820	935,500
			Arizona, ..	10,240	56,000
			New Mexico, ..	64,084	142,075
Total Pacific slope,	527,045	1,747,800	Total Rocky Mountains, ..	432,464	6,780,371

"The district inspectors, who must live within their district, appointed upon recommendation of the chief of division, and placed under bonds, are responsible for their districts and the acts of their rangers, and report to and advise with the central bureau; they superintend and regulate in detail the cutting of timber and other necessary or prescribed work, see to the execution and observance of laws and regulations, and act as intermediaries between the public and the central bureau.

"The central bureau, under a commissioner, with three division inspectors or chiefs of division, as a council, makes the regulations for district inspectors and rangers, has disposition of the funds, according to the yearly budget, fixes price and conditions for the sale of timber, and grants privileges from year to year, determines manner, method, and time of cutting, &c., and, in connection with the Land Office, prepares the mapping of districts and the legal work.

"The chiefs of division ought at least once a year to make an inspection tour over their division, composed of a number of districts, and so laid together as to facilitate their inspection. One for the Pacific slope, one for the Rocky Mountain region, and one for all other timber lands might suffice in the beginning.

"(6). The disposal of timber to be cut under the regulations of the central bureau, with a view to natural reforestation, should be made on the stump, and in the first place for the requirements of local demand only.

"The localities and areas to be cut over, also the lowest selling price for timber, if even only nominal, must be established yearly upon the report of the district inspectors as to applications and local requirements, revised by the chief of division; so that in proper season the places where cutting will be allowed, the conditions of sale and other regulations, the Government rate, &c., can be advertised, and at stated days in each district, the timber may be disposed of at public auction to the highest bidder, who must deposit the amount of his bid with the central bureau before cutting. Where local supply is the main object of such sales, they should be in small parcels to suit. Where lumbering is to be considered above local need, larger parcels may be disposed of.

"Permission to erect saw-mills, &c., should in every case emanate from the central bureau, which acts as the administrator of a valuable property, and should be given the greatest latitude in the division of the territory, the use of its forces, and in arranging for the co-operation of local and State authorities. Such an organization would require, besides the head of the bureau, only three thoroughly trained foresters as chiefs of divisions. The district inspectors are best chosen from men conversant with lumbering operations and woodcraft and with some knowledge of and interest in forestry. The guards may be simply reliable men of discretion.

"(7). The cost of the total service depends of course on the number of districts to be formed. Take Colorado alone, which we will assume contains about 5,000,000 acres of public domain; for this we may require 300 rangers and 10 inspectors, and the expense may be placed in round figures at $300,000. This amount could be saved by preventing only one-third of the forest fires, which seem to destroy over $900,000 worth of public property in that State yearly, and the 50,000,000 cubic feet or so of timber, which may be cut to satisfy the needs of the country for its development, would certainly, without hardship to any one, yield enough to help pay the expense of less favorable localities and of the central bureau. The expense of the latter, with the necessary staff of clerks, &c., could certainly be kept within the sum of $50,000. Even if the whole forest area were as thoroughly organized as proposed for Colorado, the expense of the service would not be more than 30 per cent of the income which might be derived from this domain, or, which could be saved, by preventing one-half of the fires that yearly destroy about an equal amount.

"Thus the matter of cost appears as nothing. But I repeat that if the total income from the domain were spent upon its preservation and improvement it would not be an extravagance, and future generations of farmers, miners, builders, nay, of lumbermen, would extol the wisdom of the legislature which thus preserved the needful forest cover of the mountains.—B.E.F."

The question of expense cannot certainly be considered in the United States, where the vast surplus of annual revenue, which their protective duties entail, might be well disposed of by re-acquiring full possession of a sufficient area of State forests for the national requirements.

Mr. Fernow anticipates that the end of this century will see the appropriation in private hands of all the readily available farm lands, and then the need and true value of scientific forestry will make itself widely felt. The lesson will in our opinion be a sharp and severe one, and it is a slur on the Anglo-Saxon race that its principal branch is allowing the future of a Great Continent to be compromised, when all the nations of Europe and the Indian Empire afford examples of properly organized forest management.

Apart from the assurance of the permanency of State forests, which must be created at the expense of private rights if the physical and climatic features of the country are to be preserved, and its timber and fuel requirements met, Mr. Fernow's report contains many points of interest.

The Government, instead of facing the difficult question of demarcating and preserving State Reserves, is collecting biological

data of forest trees with the view of publishing a life history of the chief American species. This is an excellent work, but in India we have wisely first secured our State forests, and then set to work to learn how to manage them.

The Forestry Division has not found it an easy matter to distribute seedlings for private planting, but its work of furnishing data regarding the condition and importance of the forests and supplies of forest produce in the United States, and of presenting the methods of forest management of other countries as an aid to their own legislators in formulating a forest policy, may be deemed concluded.

Mr. Woodrow briefly summarizes the results of this enquiry, and as parts of this summary are of general significance, we quote them for the benefit of our readers—

"Owing to the short time since methodical observations have been inaugurated (mainly in Germany), and the complicated nature of the investigation, the numerical data relating to forest influences are still exceedingly incomplete.

"The most notable figures, so far more or less definitely established as general averages, are given as follows :—

"The temperature of the soil in the forest (always meaning a well-stocked dense growth) is lower than that of the open field; in spring, by 28 per cent.; in summer, by 24 per cent.; in autumn, by 16 per cent.; in winter, by 10 per cent.; in the average during the year, 21 per cent.

"The temperature of forest air (interior) is lower than that of the fields, the difference being greater in proportion to elevation, and less in the region of the crown than nearer the ground. The difference in absolute temperature degrees is greatest in spring and summer, from 15 to 20 per cent.; in fall and winter the difference is small, the temperature in the forest being somewhat cooler during the day, but warmer during the night. On an average a reduction in temperature of 10 per cent. from that of the open field prevails during the year.

"In the case of Kansas, for instance, this would mean a reduction in summer temperature of 10 to 15 degrees in a supposed forest, with all the consequences of reduced evaporation, cooler winds, and increased precipitation. The thermometrical range is from 5 to 20 degrees less in the forest than in the open, the greatest difference occurring in the hot months.

"The relative humidity of the forest air has been found to be from 3 to 10 per cent., and in pine forests in summer as high as 13 per cent. greater than in the open. Observations in France place the difference at 1 to 3 per cent. in favor of deciduous, 7 to 13 per cent. in favor of pine forest, the greatest difference occurring in the summer months.

"Evaporation in the field is greater by 57 per cent. in spring, 64 per cent. in summer and winter, and 66 per cent. in autumn.

"Transpiration through the leaves during five months of vegetation, for a field with vegetable cover, has been estimated at 500,000 to 1,500,000 pounds of water per acre. Forest vegetation requires several times (probably three times) this amount.

"Amount of precipitation over forest was found to be from $\frac{1}{2}$ to $1\frac{1}{2}$ inches (1·4 per cent.) greater in deciduous, and from $1\frac{3}{4}$ to $2\frac{3}{4}$ inches (8 per cent.) in evergreen forest. (These figures are probably too low).

"The amount of precipitation reaching the soil is dependent on the greater or less force of the rain, fine rain often being entirely intercepted by the crowns, while 80 to 90 per cent. of very heavy rain may reach the ground. When falling at the rate of $\frac{1}{4}$ inch in 24 hours, spruce forest intercepted 78 per cent., beech 27 per cent.; when at the rate of $\frac{1}{8}$ inch in 24 hours, spruce intercepted 95 per cent., beech 62 per cent. Yet observations in France through 11 years in a 40 to 57-year old beech forest show that only from 8·5 to 17 per cent. of the precipitation was intercepted. Last year's observation at the Prussian stations show the precipitation decreased under forest cover by 23 per cent."

Regarding the condition of forest supplies in the United States, we read as follows :—

"The forest area of the whole United States, excepting Alaska, at the present time has been reported by the Forestry Division as less than 500,000,000 acres (489,280,000).

"There is reason to believe that much of this area is waste brush-land, and that even the timber forest often hardly deserves the name, being only thinly stocked with trees.

"Leaving out of consideration the forests of the Pacific slope, estimated at 60,000,000 acres, and said, though little known, to cut large amounts per acre, the balance of forest land in the United States, it is believed, cannot long meet the enormous demands on its resources.

"No reliable statistics exist from which the stock on hand could be even approximately computed for the whole extent; but we do know tolerably well the quantity of lumber and wood annually used or required by our present population. In round numbers this amounts to something like 20,000,000,000 cubic feet, made up of the following items :—

	Cubic feet.
Lumber market and manufactures, ...	*2,500,000,000
Railroad construction, ...	†360,000,000
Charcoal, ...	†250,000,000
Fences, ...	‡500,000,000
Fuel, ...	§17,500,000,000

* Computed from figures of the Bureau of Statistics.

† Latest estimates of the Forestry Division.

‡ Computed on the basis of a careful investigation by the Department in 1871.

§ Computed on the basis of census statistics of 1880.

"There is also to be added an item requiring yearly a considerable mount of wood for a use to which no other civilized nation puts its forests. I refer to the 10,000,000 acres or so of woodland burnt over every year, intentionally and unintentionally, by which a large amount of timber is killed or made useless; and, what is worse, not only is the young growth destroyed by these fires, but the capacity of the soil for tree-growth is diminished, as they destroy the beneficial physical qualities of the leaf-mould; and if occurring on recent clearings, inferior kinds of timber, capable of thriving under the altered conditions, occupy the ground and diminish the value of the area.

"The present reckless method of turpentine-orcharding also deteriorates large quantities of timber unnecessarily.

"The wasteful methods which are employed in lumbering, especially by the tie-cutter,* often avoidable without financial loss to the lumberer, hasten the reduction of visible supplies.

"What amount of forest products will be required by the country by the next centennial it is idle to attempt to compute; that it must increase with the growing population and development is self-evident, and that, too, in spite of substitutes for wood in many branches of industry.†

Area required.

"So far we have lived upon our forest resources without considering whether we were using up the interest or the capital.

"Assuming that we shall need a continuous supply of only the 20,000,000,000 cubic feet computed above, it would be of interest to ask what area in forest will be required to furnish the amount continuously.

"With our present knowledge there is no possibility of calculating the average yearly growth that can be expected upon the entire present forest area of the United States. While I am inclined to think that the capacities of the soil, climate, and indigenous species of our country are greater than those of Europe, yet in their present condition our forests do not compare favorably in regard to annual yield with the well-cared-for and well-stocked continental forest areas.

"The average yearly accretion per acre in German forests has been computed at 50 cubic feet, or on every 100 cubic feet of standing tim-

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* It is computed that in the California redwood forests to produce a railroad-tie worth 85 cents, timber to the value of $1·87 is wasted.

† It is significant to note that other nations are aware of our deplorable condition in regard to future forest supplies. The Government of Bavaria last year sent an expert forester (Dr. Mayr) to study the timbers of the United States, who explained the purpose of his mission in these words:—"In fifty years you will have to import your timber, and as you will probably have a preference for American kinds, we shall now begin to grow them, in order to be ready to send them to you at the proper time."

ber 2·3 cubic feet of new wood yearly. Applying these figures to our present requirements, and assuming as close a use of material as is the European practice, it would appear that an area of not less than 400,000,000 acres must be kept in well-stocked forest to give us a continual supply for our present needs.

"We are nearing therefore (if we have not yet reached) the time when increased drain means a squandering of capital, and a time when regard to the husbanding and the careful management of our forests is required for the purpose merely of furnishing raw material."

Mr. G. W. Hotchkins, Secretary of the Lumberman's Exchange at Chicago, is quoted as follows :—

"So far as White Pine (*Pinus Strobus*) is concerned, it occupies to-day a position in forestry analogous to the Indian in the body politic, practically a thing of the past. Of course there are sections which will last for many years (not so very many either), but the great bulk is gone, and, like the straggling tribes, but a remnant of former strength and power remains, and but a few decades more and they will be known only in history as a thing of the past. One hundred years ago Maine, Vermont, New Hampshire, New York, and Pennsylvania could boast vast forests of White Pine. West of the lakes, Michigan, Wisconsin, and Minnesota, so late as fifty years ago, were unbroken in forest resources, and the White Pine predominated. To-day Maine gives us some spruce and a little small sapling pine, such as would hardly have been sent for firewood in her palmy days of lumbering. Vermont, New Hampshire, and New York may still boast an occasional clump of trees, but have lost all pretensions as lumber-producing regions. Pennsylvania has a few hundred million feet on the sides of the Alleghanies, but has dropped out of the list as a lumber producer. East of the great lakes nought remains (excepting the spruce forests of Northern and Eastern Maine) save hemlock and hard wood, and these in very limited quantities, insufficient to supply the home demand in a majority of localities. Michigan, Wisconsin, and Minnesota are the last remaining resorts for lumbermen east of the Rocky Mountains. Originally there was probably 150,000,000,000 feet B. M. in Michigan, but 50 years' work has reduced the supply to probably not over 12 to 20,000,000,000 feet, with an annual average cut for the past five years of not far from four-and-a-half billions; and the cutting is so close as to exterminate all the pine timber on the tract operated upon. Wisconsin can hardly be estimated at over 30 to 35,000,000,000, little more than would suffice to supply the consumption of the United States as a whole for one year. Minnesota, set down in the census of 1880 as having 11,000,000,000 feet B. M., an amount disputed by some as too high, by others as too low, if allowed to-day at 10,000,000,000, could furnish but one year's supply for the

mills of the North-western pine-producing States. In fact, if the mills of these three States were run to their capacity for six years there would be but little pine left for the seventh year's production. And these estimates of timber include the red or Norway pine, which forms a noticeable percentage of the whole. In Michigan and Wisconsin there are still large quantities of hard wood, but it is not being cared for with that appreciation of its value which is desirable. It has, however, this advantage, it can be reproduced. Pine cannot.* The future timber supply of the East must be largely from the hard woods. The vast forests of the Pacific slope will supplement this with such soft lumber as may be needed. Before many years the forests of Alaska will swarm with enterprising timber seekers. Already those of California, Oregon, and Washington Territory have been the subject of research, and vast amounts of Eastern capital are already invested there. British Columbia, west of the mountains, will supplement the supply, but our children will bring their pine and fir from Alaska. Meantime the supply east of the Rockies once denuded will be known no more, except through wise Government action in protecting and encouraging timber culture. Our present laws in this respect, so far as they relate to taking up land, are a farce, falling little short of tragedy, as the Government parts with the land without accomplishing the purpose of the grant in one case in a hundred, until it has lost control of all sufficient areas, which might be made a blessing to our successors in life's race.

"I have not for some years given the subject of Southern production so much thought, so far as statistics are concerned, and can speak only generally. There has been a great impetus to trade in the South during the past five years. You will be safe in computing the consumption of all kinds of wood at 500 feet per capita of the population, and at 8,000 feet per acre, it would take about 4,000,000 acres per year for its supply. In Southern timber both the Long-leaved and Loblolly Pine grow and can be reproduced in their native soil, so that the statement above that "pine does not reproduce itself" applies only to the White Pine of the North. I know of no good reason why Government endeavors to foster and perpetuate large areas in the South would not be eminently successful. But it should not be delayed, as the wastefulness which has brought the White Pine resources of the North so near to their extinction is rapidly doing the same for the Long-leaved and Loblolly of the South. It is to me a source of surprise that some of the lumbermen of the country, men who are or have been for scores of years tramping through the forests, are but now awakening to a perception of the true condition of our forests. That they have opened their eyes to the truth is made

* This can mean only reproduction from the stock. Reproduction of White Pine from seed is as easily effected as that of any other conifer, but of course requires special management, as will be outlined further on in this report.—B.E.F.

evident to those who, like myself, are in position to know of the search which is being made for desirable bodies of timber, by men who six years ago set down the Government estimates and statements as veriest bosh, and loudly asserted that no diminution in present annual supplies would be seen for a generation to come."

We also read further on that the second growth of White Pine is cut when only fit for box boards, and will not figure in the market for building material, as it requires 90 years for it to attain the requisite qualities for building purposes, and the long leaved pine (*Pinus palustris*) is said to require 200 years to furnish timber of good quality.

The hard-wooded forests are more easily reproduced than those of conifers, but complants of the deficiency of hard-wood for manufactures are already plentiful.

The enormous yield of the Pacific slope forests will furnish timber for many decades, but must eventually succumb to the demand, whilst the forests of the Rocky Mountains can only yield timber for local requirements, though as holding snow and water for the use of agricultural lands, and in lessening torrential action their maintenance is essential for the national prosperity.

Regarding imports and exports we read as follows :—

"The imports of forest products from Canada form naturally the bulk of our importation, amounting to $9,355,736 for the year ending June 30, 1885, equal, perhaps, to round 75,000,000 cubic feet. Almost the entire cut of the Province of Ontario, amounting in value to $7,371,028 for the year 1884, comes to the United States. This shows that the duty of $2 a thousand feet does not prevent competition, and also that from its abolition little hope is to be drawn for the preservation of our resources. In Canada there can be little doubt that all the possibilities of production are even now strained to the utmost.* The exportation of forest products from Canada used to go entirely to Great Britain and the West Indies; but since the pine lands of the North-Western States have become gradually depleted, Canadians have successfully competed with the lumbermen of Michigan and Wisconsin, till to-day their exports to Great Britain and the United States are almost equal in amount. The expressions of the Hon. H. G. Joly, member of the Dominion Council of Agriculture, show that the visible supplies of white pine in Canada are almost in the same deplorable condition as those in the United

* For the year ending June 30, 1886, the trade and navigation returns of the Dominion show the total exportation of forest products from Canada to the United States as amounting to $8,500,000, or 40 per cent. of the total lumber export. Ontario exporting to this country to the value of $6,500,000; Quebec, $1,300,000; Nova Scotia, $270,000; New Brunswick, $438,000.

States, and that the prospect of supplying our needs by importations from Canada is altogether not very encouraging."

Here follow tables from which we extract the total figures—

Imports for consumption of wood and wood products, 1883-86.

1883-84.		1884-85.		1885-86.	
c. feet.	Value in dollars.	c. feet.	Value.	c. feet.	Value.
85,710,000	15,427,000	75,495,000	12,893,000	79,757,000	12,471,000

Exports from United States.

1883-84.		1884-85.		1885-86.	
c feet.	Value.	c. feet.	Value.	c. feet.	Value.
15,609,000	38,754,000	127,616,000	33,267.000	128,401,000	31,756,000

The value includes among *imports* besides wood, bark extracts, chiefly hemlock, sumac and cork, and under *exports* resin, turpentine and pitch, bark and tanning extracts and sumac.

Here follows proposals for Government plantations in the arid and semi-arid regions of the Western States.

It is said further on, that the bulk of the once endless forest area is held by railway companies, mine owners, charcoal iron works (3,500,000 acres), tanneries and other industrial establishments. The largest amount is in the hands of lumbermen, speculators and farmers.

The last class may be expected to devote most care and attention to their forests, and they own 39 per cent. of the area, or 190,255,700 acres.

The difficulties in the way of introducing sound principles into the management of the private forests are very great.

The Government has sold the timber domain at nominal prices, and such quantities of lumber come into the market, that mills can only be profitable when driven to their utmost capacity of production, and lumbermen will not, therefore, assume the additional expense of proper forest management.

There are still millions of acres of unoccupied agricultural land, but this is being settled at the rate of 17,000,000 acres per annum, and by the end of the present century, probably all readily available farm lands will have been disposed of.

Mr. Fernow gives the conditions of Forestry as follows :—

(1). Large contiguous areas stocked with forest growth.

(2). A capital, represented by such area, tied up for a considerable time before paying accumulated interest.

(3). Careful management, yielding full results only after a term of many years.

(4). Considerable risks in sparsely settled countries from fires, which are liable to destroy capital and interest alike.

(5). A business in which the inaugurators have less interest than their successors, and which will, therefore, be neglected, unless Government, or continuous corporations, engage in it, or foster it.

In spite of these difficulties, Mr. Fernow hopes that the farmers may be induced to manage their forests on proper principles, a hope which experience in Europe does not warrant. He admits that the greatest danger is in mountain regions, and especially on the Pacific slope, where, unless the State or national Governments demarcate State forests, little hope for the maintenance of the forests can exist, though this is a question of life for the agriculture below.

The only protection hitherto afforded to the State forests is by 21 agents over areas of 70,000,000 acres. These men reported 1,219 cases of depredation, involving $9,340,000, and recovered in various ways about $200,000. These agents are really informers and legal attorneys with no police powers, and naturally acting without the co-operation or respect of the population.

Some of the States have taken action to protect the small area of forests at their disposal, chiefly school lands granted by the Central Government.

The State of New York which owns 715,267 acres of forests in the Adirondacks, is attempting to protect it from theft and from fire.

The State of California is also endeavouring to prevent forest fires.

In Ohia the forest area has been reduced since 1853 from 54·2 to 17·4 per cent., and the horrors of the late flood are ascribed to the rapid denudation of the hill-sides, the value of the property destroyed being $60,000,000.

The work of the Forestry Division as has been already stated, is chiefly that of collecting statistics, and studying the biology of forest trees.

In the latter respect, the following schedule will be useful to our readers :—

"(*a*). *Introduction.*

"Significance of the tree in the forestry of the country; short statement justifying the investigation; historical remarks; sources of information and acknowledgments of aid; statement of methods of inquiry.

"(*b*). *Statistical.*

"1. Geographical distribution and habitat; (in general by regions,

where best developed, most abundant, covering large or small areas, continuously or only mixed in, associated with what other species, &c.).

"2. Economical importance, utilization, trade, former and present supply, acreage, amounts used, available, &c.

"3. Value and uses of the wood.

"(*c*). *Biological.*

"1. Short botanical exposé; name, size, form, root, crown, habit.

"2. Life history; development from seedling; leaves, flowers, seeds, seed crops.

"3. Influences, on form and development, of climate, soil, site, surroundings, and light and shade as compared with other species.

"4. Measurements: rate of growth in height and in diameter, in natural forest or under cultivation; at different periods of life; on different sites; time necessary to produce merchantable timber; yield of wood per acre.

"5. Structure of the wood and mode of its development; influences upon quality; illustrations.

"6. Dangers and diseases:

(*a*). From mechanical forces, human agencies, cattle, wounds, winds, snow, frost, drought, floods.

(*b*). Occasioned by influences of the soil.

(*c*). Occasioned by phanerogamic parasites.

(*d*). Occasioned by cryptogamic parasites.

(*e*). Occasioned by insects.

"(*d*). *Forestal.*

"1. Essential demands on climate, soil, and growing conditions.

"2. Associates found naturally with the species and their relative behaviour.

"3. Opportunities and requirements for natural renewal (especially considering seed crops, seed years, germination, and the need of light or shade for young plant); difficulties for practical and economic reasons; for natural reasons.

"4. Methods of management suggested.

"5. Artificial renewal.

"6. After treatment: thinning; when and how much.

"7. Rotations.

"8. Profits under different treatment.

"(*e*). *Conclusions.*

"Stating in the briefest manner, in a few precise sentences, results of investigation in regard to economic and forestal questions."

Regarding legislative attempts to encourage the growth of trees in America, we find bounties of $2 to $10 per acre for planted forest, and exemption from taxation granted by certain States, and State

lands granted on condition that one-quarter of the area should be planted up within four years, and should show 675 living trees per acre.

Under this law 30,998,855 acres have been occupied, and 652,000 acres passed into the hands of settlers.

It is said that 90 per cent. of lands thus acquired have not conformed to the conditions as regards planting.

Arbor day, or a certain day every year set apart for tree-planting, has been established in all the States following the example of Nebraska in 1874, when more than 12,000,000 trees were planted on the second Wednesday in April, and 100,000 acres of planted forest now exist.

The pupils of public schools are chiefly engaged in the observance of Arbor day, and thus a sentiment which promises good for the cause of Forestry, is fostered.

Mr. Fernow's interesting report closes with an exposition of the general principles of Forestry, and with a list of the 90 most important timber trees of the United States.

REPORT ON THE CANAL PLANTATIONS, NORTH-WESTERN PROVINCES AND OUDH, FOR THE YEAR ENDING 31ST MARCH, 1887.

THIS Report contains, as usual, besides the reports of the three Superintending Engineers, a Review by the Chief Engineer and the Local Government Resolution.

The revenue which is realized on these Plantations is sufficient to make a Forest officer's mouth water, for with an area equal only to an ordinary range at the most, *viz.*, 36,037 acres, or slightly over 56 square miles, the gross revenue has during this last year reached the goodly figure of Rs. 1,72,764, and a net revenue of Rs. 94,020, which is that of a very flourishing Forest Division.

The average net revenue per acre is Rs. 3·2 of the different Circles, the Eastern Jumna Canal heads the list with a net revenue per acre of Rs. 20, while the lowest is the Lower Ganges Canal, only yields Re. 0·68 per acre. The Upper Ganges Canal, which has the most extensive plantations, *viz.*, 15,653 acres, is nearest the average, yielding Rs. 3·68 per acre.

With all this success, the revenue obtained from canal plantations is so small as compared with that obtained from irrigation, that Canal officers can ill afford the time which successful plantations like these can well claim. The result is that the plantations

are everywhere not as well looked after as they might be, and that the produce does not command the prices it might if the plantations had somebody to look specially after them. We believe that the Canal authorities are quite willing to employ a Forest officer, but as the Forest Department itself is short of men, it is impossible to supply them. In the meanwhile, the plantations of the Upper Ganges Canal have been specially favored by receiving the services of an officer of the Irrigation Department. The Traffic Manager of the Canal, an able young officer, has been set apart to draw up rough Working Plans for all the Sub-divisions. One of the officers of the Central Circle was deputed for a short time to draw up, in conjunction with the Plantation officer, a short Working Plan for one of the Sub-divisions of the Meerut Division, which is to serve as a rough model for other Working Plans.

The administrative and executive charge of the plantations, however, still remains with Divisional and Sub-Divisional officers, who are unable to give the supervision required, and to prevent the numerous petty thefts and larcenies and the encroachment of cattle.

First of all the establishment wants re-organizing. The so-called Rangers are usually youths who have passed the Middle Class examination, whose ambition it is to be admitted ultimately into the regular staff of the Irrigation Department, and who have as much idea of inspecting their ranges properly, as of flying. The guards *(Muhafiz-pathri)* under them are badly paid and lazy; they often allow cattle to come into the plantations up to the very doors of their chaukis, and do not look properly after the timber-cutting contractors. The results of this is deplorable. Many Canal officers after having vainly endeavoured to keep out cattle by giving instructions to their subordinates, finally look at grazing herds with the indifference of despair. Surely it is time that Government should give them powers of taking compensation as laid down in Section 67 of the Forest Act. Some officers are also under the erroneous impression that grazing is hurtful only until the plants are two or three years old, and do not attempt to interfere when they see cattle in more advanced plantations.

The great ambition of Sub-Divisional officers is to have the trees of the shade line nicely pruned, so that the Chief and Superintending Engineers may be satisfied during their inspections. The plantations on the left bank, near the towing path, are often fairly looked after, but those on the right bank are left to the tender mercies of the Ranger, Muhafiz-pathri, contractors, villagers and others.

In our opinion the greatest waste of money in these plantations has been on fencing. Most of the fencing is done with the agave, but there is hardly one mile in which several gaps have not been made by villagers to let in their cattle. Indeed, at present, they have every inducement to destroy these hedges. They run little risk, and obtain gratis for their beasts, grazing, shade and water. It is only where the grass is leased out to regiments that there is a proper watch against the villagers, and there the grass-cutters' ponies mercilessly tread down many a patch with kikar or sissu seedlings.

What is wanted is to improve the establishment, do away with young Middle Class candidates, and get men fit and willing to walk about and at the same time improve their prospects. The capital laid out on this would very shortly be paid over and over again.

There is also nothing to prevent the Irrigation Department from having a special officer trained for their work.

We believe that with a special officer the Department would be able to obtain better prices for their timber. In some Divisions billets over 4 feet in girth, which are quite fit for timber, are simply put into stacks of fuel, and sold at Rs. 25 per 100 cubic feet stacked; and in the Upper Divisions of the Ganges Canal they find difficulty in selling their timber, while timber merchants from Meerut go much further, that is, into the Lower Himalayan forests and buy sain at 6 annas per cubic foot. Surely with their facilities of export, and with the large towns situated near the Canal, better rates should be obtainable. A trial or two of auctioning the year's fellings might in the end turn out profitable. At present, very few timber merchants seem to know about the wood, and thus it goes at reduced rates.

Special registers are kept in each Division, in which the number of trees in each unit and sub-unit (mile and furlong) are recorded. Nothing is said in the report under review as to whether the registers have been examined and checked by the Divisional officer. Nevertheless great diffidence is expressed as to the correctness of the enumerations. We have reason to believe that the enumerations are not at all as correct as they might be, and that the figures before us, showing the number of trees, are probably wide of the truth. The fact is, that many furlongs have a dense undergrowth of thorns, and that subordinates of the class mentioned above will not make superhuman efforts to reach a tree by cutting down a mass of thorny stuff. After all what is the use of this annual enumeration? If it were *quite* up to date it would give valuable data as to the gradual growth of the plantation, but it is impossi-

ble, without great expense, to keep the whole Sub-division free of thorn. It strikes us that a well made enumeration, done only where the jungle has been recently cleared, is quite sufficient for all purposes.

With respect to the maintenance charges, the Chief Engineer says :—

"There is an increase under planting, clearing, and thinning, and a decrease under the remaining heads, resulting in a reduction of Rs 1,432 in the year's outlay. Information under sowing operations somewhat meagre. The Aligarh and Bulandshahr Divisions should be called upon for particulars. As might be expected from the nature of the season, a large reduction is shown under watering, but the heavy outlay, solely confined to one Division, the Anúpshahr, calls for further explanation, and points to the necessity for closer check. *The extensive clearing and thinning operations in the Meerut Division are noted with approval.*"

The italics are ours. Turning to the table of the Upper Ganges Canal giving detail of expenditure, we see that in the Meerut Division only Rs. 152 were spent on sowing and Rs. 30 on planting. The latter only refers to repairs to the shade line. Against this outlay on sowing the outlay on felling, stacking and carriage to depôts (at Muradnagar, Jani and Nanu, on the canal) amounts to Rs. 3,783. The comparison speaks for itself.

A great deal of money has to be spent on clearing and thinning. This is a very necessary operation, for if left alone the plantations simply get choked with shrubby growth. Most of the shrubs coming up naturally are such as have edible seeds, and which probably have been disseminated through birds. Many of these are thorny, the most important being several species of *Zizyphus*, *Capparis horrida* and *aphylla*, *Diospyros montana*, *Carissa* and *Balanites Roxburghii*. There is enough spontaneous forest growth in these Canal plantations to give light occupation to a botanist. It is curious to notice how, the nearer one gets to the foot of the Himalayas, the nearer the spontaneous growth gets to be like that of the forests at the foot of the hills.

Of all these, the hins, or makkai (*Capparis horrida*) is the most troublesome. It climbs up trees and covers the ground, and in various ways renders work very difficult.

It would be a good thing if the tops of trees were not left in the fellings. These get covered with a dense growth of wild pumpkin, and render spontaneous tree-growth, as well as a proper inspection of the plantations, almost impossible.

Taking everything together, we think the results obtained are highly creditable to a Department which has its time fully occupied

with irrigation work. We fully sympathize with its officers for having to do a work which really does not belong to their "trade," and hope that shortly their wishes may be realized, and that they may get one or more special officers to be responsible for the whole of the plantation work. The appointment of a Plantation officer on the Upper Ganges Canal has been a step in the right direction, and he will, no doubt, give hints to Divisional officers as to the ways they must follow.

The report ends with an Inspection Report by the Conservator of Forests, Central Circle. This begins with short descriptions of the plantations visited, and suggestions as to planting certain portions and as to fire protection. Lower, the subject of usar plantations is dealt with, and Mr. Bagshawe considers that fodder reserves could easily be made out of the worst usar plains, but that there is nothing, as yet, to indicate that the culture of cereals can be re-introduced on usar tracts.

The next point dealt with is the appointment of a special officer for plantations, and Mr. Bagshawe's opinion is very much the same as ours. He also is very strong on the point of subordinate establishment, and fights especially against "young men who have just passed the Middle Class examination, to whom Rs. 10 a month is but a first step, and who are, as a rule, better munshis than working men."

We cannot do better than to wind up with his words—

"A sound system of management will insure the Canal plantation yielding a large supply of fine timber, as well as a valuable outturn of fuel, and, with the present expenditure, should give an enhanced revenue. The present varying system of management fails to produce good timber, or to do the best with the funds allowed for works; while it must make the plantations much more troublesome to work than they need be."

DESCRIPTION OF GEAR EMPLOYED FOR FACILITATING THE TRANSPORT OF TIMBER BY LAND.

THE annexed Plates by Mr. M. H. Ferrars, Deputy Conservator of Forests, were drawn to illustrate his Report on Forest Administration in the Andaman Islands for 1885-86.

Departmental working of timber is chiefly employed, and 26 elephants were used for the work at the end of 1886. They are fed on green fodder without any grain, and have worked on the average 214 days. There were three casualties during the year.

The Government saw-mill turned out 471 tons of wood, padouk planks, garjan telegraph posts, &c.

The following description of the gear for facilitating the transport of timber is given as an appendix :—

"1. Timber-trucks—*Figs.* 1, 2, and 3, *Plate* IV., and *Plate* I.

"The frames of the trucks are of Nagésar ('Gengaw'—*Mesua ferrea*) and the wheels of padouk. The frames are all uniform, but wheels of three sizes are used, *viz.*, 3 feet, 3 feet 6 inches, and 4 feet diameter. The 3 feet wheels are each of a single piece, with $\frac{3}{8}$-inch iron tires shrunk on. They have no bushes. The larger wheels are constructed of four semi-circular pieces (as in *Fig.* 1, *Plate* IV.), bolted together cross-wise, so that where the face of one-half has the grain lengthways, the face of the other has the grain end-on. The axle hole is prepared in each such segment of a wheel before the segments are joined together: a gutter is left in the middle round the bearing, to hold tallow. With sundri or sál axles, the lower or bearing surface of the axle would need to be faced with metal.

"The arrangement of the trucks for road work is shown in *Plate* I. Two trucks are set back to back, and kept from separating by a chain which passes through the axle tree-hook (*k*) of each and makes a figure eight over the load. The load is kept in position by vertical bars (*dd*, *gg*), stepped in the holes in the axle-tree and in the parallel beam (*p*), which binds the rear of the frame. There are two sets of these holes, right and left, to suit logs 2 feet, 2 feet 6 inches, and 3 feet diameter. Water drains off at *bb*. Whichever truck is taken for fore-carriage, has vertical bars stepped in the axle-tree only. This allows the fore-carriage axle to pivot freely under the load and to take whatever lead is given at *r*, the hook by which the elephant draws. The hind-truck has the four vertical bars stepped, *i.e.*, two in the axle-tree and two in the beam *p*. The log is wedged up between the four bars when needful, so as to look firmly and keep square with the axle-tree. Both axle-tree and beam *p* are furnished with iron plates along the top, through which the holes pass in which the vertical bars are stepped. These plates strengthen the edges of the step-holes and save the axle-trees, &c., where the log bears and pivots. Where obstacles have to be avoided and very sharp turns made, the bars *gg* of the hind-truck can be taken out, and this truck also steered. The hind-truck can be converted into the fore-truck by transferring the bars *gg* from one to the other, and applying the power from the opposite direction. Thus, the trucks and load can be ranged into any position. The notches at the ends of the axle-tree are for wire-rope traces, by which to yoke a second elephant '*tandem*,' for steep ascents, with very heavy loads over freshly or roughly metalled roads or bad ground. The first illustration shows the application of the brake, bringing a load down a narrow and curving metalled gradient of 1 in 8, which occurs in the road the trucks daily travel over.

"The supply of logs for telegraph posts by the saw mill, depends entirely upon these trucks.

"In the forest itself, from October to June, the trucks work well. It suffices to lift one end of a log upon the axle-tree of the truck, between two vertical bars *(dd)*, and to allow the other end to trail. The truck best suited for this work is one with the beam *p* left away.

"The logs are jacked up with long wooden hand-spikes and large wooden bricks, first a little at one end, then to the full height of the axle-trees, in the middle: and the trucks are run in from each end, the vertical bars and chains fixed, and the log lowered. A gang of eight men can thus load and transport for two to three miles and unload and put in the water one to two logs a day of four to eight tons measurement, and five to ten tons in weight. On the level and on hard and fairly even ground, the elephants can travel with these loads at their ordinary walk.

"A plain Nagésar axle without metal sheathing to the bearing surface lasts a couple of months; with sheathing, an indefinite period. Padouk solid wheels, tired with iron, but without metal bushes, last two years and more. Without tires they last a few weeks only. The trucks, with their broad iron tires, act as powerful road-rollers. Between June and October the trucks can be worked in the Andamans upon metalled roads only.

"*Plate* II. shows a simple kind of 'trestle' gear, which has proved very efficient. It consists of two ordinary broad-gauge sleepers (10′ × 10″ × 5″), pierced in the middle with a 2 to 3-inch auger-hole, through which is thrust a stout iron gas-pipe, about 5 feet long. The sleepers are fitted with ring bolts at the ends, facing alternate ways. A slack chain-sling suspends the log from the crossbars, about quarter way from the fore-end. Other chains hold the gear from working forward. The illustration shows the gear at the stage of one-third of the half revolution. The latter, when complete, brings the alternate pair of ring-bolts into position for shifting the hooks of the drag-chains into. Under ordinary circumstances, two half-revolutions occupy one minute, and cause the log to travel four yards. The gear is, of course, only applicable to logs, which are beyond the power of an elephant to drag direct. The method is of service for getting heavy timber *ex situ* to the nearest practicable path for wheel-trucks. With the chains, the crossbar, the ring-bolts, and the help of wood-augers and a wrench, the gangs can construct the tackle themselves in the forest. The tackle works well from October to May.

"*Plate* III. shows a very simple sleigh for use when the ground is too much sodden with rain for the timber-trucks. Since the close of the year, it has been employed with much success at Shoal Bay. It consists of one piece of wood of the shape of a flattish spoon, truncated above the

PLATE I.—Trucks for transport of heavy timber, with elephants or bullocks, (showing brake in operation).

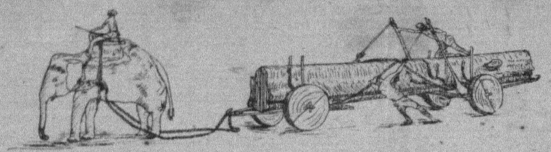


PLATE II.—Trestle-gear for moving heavy timber with elephants.

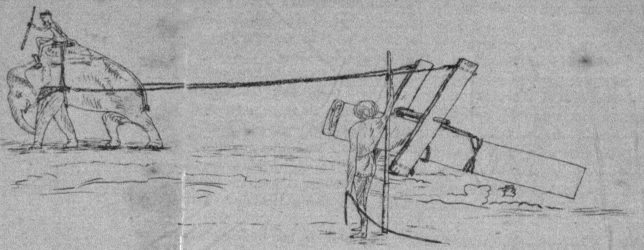


PLATE III.—Rough sleigh for facilitating the dragging of timber by elephants.

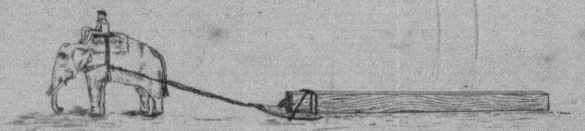
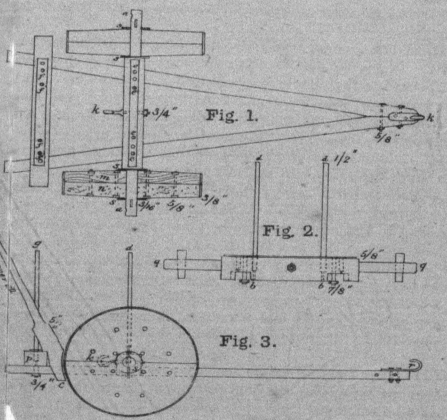


PLATE IV.—Diagrams of Trucks designed for transport of heavy timber by roads.

Scale, inches to feet.

12 6 0 1 2 3 4 5 6 7 8 9 10



Litho. T. C. Press, Rootker.

THOS. D. SONS, Supdt.

base, such as may be obtained from the buttresses of trees in the Andamans, and is 6 to 8 feet long by 4 to 5 feet wide at the base and 3 to 4 inches thick. It is dragged from a hole at the apex. The log is lashed from two holes at the sides. By keeping the fore-end of the log well raised, it prevents the log from bearing upon the ground throughout its length, as in plain dragging, and thereby greatly reduces friction. By its breadth, it makes a good flat road. It cannot plough into the ground, as do the logs dragged direct, and it passes over soft slush without sinking in. It cannot jam, nor allow log or chains to catch and jam against stumps and projecting rock. It is of special service for transport of finished hull-squares, dressed ready in the forest; and it enables squares to be dragged whole, and with ease, to the elephant, which would otherwise have to be cut in halves, to lighten them."

III. Official Paper.

INSECTS INJURIOUS TO FORESTS.

We republish the following Circular letter from Sir E. Buck, Secretary to the Government of India, dated 16th February, 1888, and hope that some of our readers may be induced to collect and forward specimens of insects and of the damage they do :—

The Inspector General of Forests has drawn the attention of the Government of India to the fact that there are no books or papers relating to injurious Forest Insects in India, that little knowledge exists regarding them, and that no representative or satisfactory collections of them are in existence.

The question is one of practical, as well as scientific, importance, and should, in the opinion of the Governor General in Council, be brought under the early consideration of Local Governments and Administrations, with the view of instituting some systematic arrangements for providing the requisite collections and information through the agency of the Forest Department, with such additional help as may be procurable.

It has been suggested to the Government of India that a central depôt should be established at the Dehra Dún Forest School, to which all Forest officers in India should be asked to send specimens of as many species of insects as they can collect, and, if possible, not single specimens, but a dozen or more of each sex in the various stages of transformation. At the Forest School, these specimens would be sorted into their respective families, and a certain number belonging to each species of a family would then be sent to some one who may agree to take up that special family or part of the family, to be made up by him into, say, half a dozen identically numbered separate collections, for deposit in the museums at Cooper's Hill College, the Forest School, Calcutta, and elsewhere, as well as for submission to such scientists as would undertake to work up the subject of Indian insects in further detail. It is proposed that such collections should be despatched whenever 25 specimens have been so arranged and, as far as they can be identified,

named. It is not intended that the collections should be restricted to "injurious Forest Insects" only, but that they should comprise whatever insects come under the observation of collectors, as by this means a comprehensive and accurate catalogue of Indian insects would be rapidly prepared, from which any insect that may be found to injure agricultural crops and produce could also be identified. As regards "injurious Forest Insects," it is proposed that Officers should send to the Forest School, together with the specimens of the insects themselves, also specimens of wood, leaves, fruit, &c., illustrating their ravages, as well as such notes regarding their life-history as the collectors have been able to make. These notes would be printed in the form of slips and sent with the specimens to the gentlemen who have undertaken to set up the collections, and to those scientists who may volunteer to work up the family to which the particular insect belongs.

The plan sketched out in the preceding paragraph commends itself to His Excellency in Council as one which will tend to establish a solid ground-work for further scientific enquiry of a more exhaustive character, without either necessitating scientific knowledge in the individual collectors, or making an undue call on the time of already hard-worked officials.

In these circumstances, the Governor General in Council invites the to permit the Forest Officers in to be associated in the investigations which are contemplated. It would, in that case, be desirable that they should be instructed to collect such insects as may come under their observation, and to send, if possible, at least one dozen complete specimens of each species so collected to the Director of the Dehra Forest School, the cover of each box, case, or bottle, being marked "*Insects.*" A copy of Mr. Clifford's Memorandum on killing, preserving, and transporting insects is appended.

I am also to suggest that enquiries may be made of the Forest Officers in , and from such other gentlemen who may take a special interest in Entomology, whether any of them are willing to work up and, if possible, to name any special family or part of a family, and to set up the identically numbered collections of such family intended for Cooper's Hill College and the Dehra Forest School, and for these entomologists of note who may be found willing to help in the work. The result of these enquiries should be submitted to the Government of India at an early date.

I am to add that an acknowledgment of all specimens receiv-

ed at the Dehra Forest School will be made monthly in the pages of the "Indian Forester."

I am in conclusion to state that a copy of this Circular will be forwarded to the Trustees of the Indian Museum, with the view of obtaining their co-operation and the assistance of their scientific staff, which, as will be observed from the appended copy of letter No. 38—9-3 A., dated the 20th ultimo, has already been invited in connection with Agricultural Entomology.

Memorandum on killing, preserving, and transporting Insects.

For killing insects, the best thing is a tin cylinder—say, an empty tobacco-tin—with a closely fitting removable cap-lid at each end. The ordinary half-pound tobacco-tin, which is about 6½ inches long with a circumference of 9¾ inches, is a convenient size for most insects. Into this a perforated tin diaphragm may be fixed, at about 1½ inches or 2 inches from one end of the cylinder. The larger chamber will contain the insects to be killed, while the smaller one will be used as a receptacle for poison.

The most effective poison against insects is cyanide of potassium, but its peculiar property of deliquescing with either heat or moisture makes it difficult to use. I have tried making up strong solutions of it with plaster-of-Paris (calcined gypsum), but I find the effect goes off too rapidly, and the hardened cake soon becomes perfectly innocuous. I have also tried enclosing solid pieces of cyanide of potassium in plaster-of-Paris, but I have not yet succeeded in getting the plaster to set properly. Should further experiments in this direction turn out better, I hope to be able to supply a convenient form of insect poison to any one who wishes to possess it.

Hitherto I have employed essential oil of almonds, a drop or two of which on a small piece of sponge is quite enough to fill a tobacco tin with strong fumes of prussic acid. In place of the oil, ordinary flavouring essence of almonds may be used, but its effect is not so good. The oil may be obtained from any chemist at every large station, while the flavouring essence is procurable from all provision dealers. Ordinary benzine is also very effective, and is easily obtained from any chemist. It has further the property of removing greasy stains from the wings of moths, when directly applied. Before being placed in a collection, the insect should be painted over with a fluid composed of—

1 quart of methylated spirits,
1 oz. of mercuric chloride (corrosive sublimate).
1 oz. of carbolic acid.

This will preserve it from insects and mould.

Larvæ of insects—grubs of beetles, bees, wasps, &c., and caterpillars of butterflies and moths—may be preserved in spirits of wine.

For transmission by post, larvæ may be sent in bottles of methylated spirits. Beetles, grasshoppers, and hard-bodied insects generally, should be placed in tin-boxes with saw-dust, over which benzine should be liberally sprinkled.

The various species of insects in one box may be separated by layers of paper. Lepidoptera (butterflies and moths) should be packed, with their wings together, in pieces of paper folded into triangles with the edges overlapping. The specimens must not be left loose in the box, but so arranged that they cannot be shaken in transit. When packed with insects, the box should have all its interstices covered with gum paper carefully applied so as to exclude all enemies.

DEHRA DUN,
4th August, 1886.

M. H. CLIFFORD.

No. 38—9–3 A., dated 20th January, 1888.

From—SIR E. C. BUCK, *Secy. to the Govt. of India, Revenue and Agricultural Dept.*

To—*The Secretary to the Trustees of the Indian Museum, Calcutta.*

I am desired to ask that you will be good enough to place before the Trustees the question whether the systematic study of Agricultural Entomology can be taken up by any one of the officials of the Indian Museum. The suggestion has on more than one occasion been brought before the Government of India that an officer should be specially appointed (as in America) as Government Entomologist, for the investigation of insect pests and of the remedies which may be applied to counteract the injury to Agriculture attributed to them. I am, however, to point out that there is no reason why, if the Trustees of the Museum are willing to place the responsibility of such work upon one of their staff, any additional agency should be employed.

If the Trustees are prepared to meet the views of the Government of India in this matter, I am to suggest that they should permit any officer who may be entrusted with the duties involved in the study of Agricultural Entomology to be placed by the Government of India, with the consent of Local Governments, in direct and personal communication with the Director of the Agri-

cultural Department in each Province. It would appear to be essential that some means of obtaining continuous information and practical assistance in different parts of India should be provided, and that the officer nominated for the work should, sooner or later, be permitted to visit the various localities which are affected by insect pests. If this course be taken, it will be desirable that the co-operation of the officers of the Agricultural Departments, who have under their control a fully organized machinery for procuring information regarding all agricultural circumstances, should be ensured.

In connection with the Insect Pests of India, the attention of our readers is directed to the Circular issued by the Trustees of the Indian Museum, Calcutta, given on page 192 of the April Number.

FORESTRY IN VICTORIA.—It is intended by the Government to invite applications from persons qualified to act as Conservator of Forests at a salary of £650, with annual increments of £20 a year. Some months back an announcement was made to the Lands Department that it was probable that Mr. J. Ednie Brown, Conservator of Forests of South Australia, would accept a similar appointment in Victoria if the offer were made to him. Mr. Dow accordingly wrote to the Commissioner of Crown Lands of South Australia on the subject, and received a reply from that Minister that Mr. Brown was a most valued officer, whose services the Government would regret to lose. It is very probable, however, that Mr. Brown will apply for the position now being advertised, and it remains to be seen whether, in view of the strongly-worded letter of the Commissioner of Crown Lands of South Australia, he will be engaged by Mr. Dow. Concurrently with the appointment of the new Conservator, efforts will be made to place the forest branch on a different basis. A comprehensive Forest Bill was submitted to Parliament last session, but it was never pushed beyond the preliminary stages. Mr. Dow considers that with the reservation of large areas of land, and the employment of a skilled Conservator, he will be able to develop forestry in Victoria without any radical alterations in existing legislation. The gentleman appointed will be placed in the professional division, and will be regarded as the head of the Forestry Department.—*Melbourne Argus*.

JV. Notes, Queries and Extracts.

CONIFERS.—THE SOUTHERN OR PITCH PINE.—*Nomenclature.*—This is the *Pinus Australis* of Michaux, otherwise the southern pine, from its abundance in the Southern States of America. From being a well-known and a useful tree it bears a full crop of names. In the Southern States it is known as the long-leaved pine, yellow pine, pitch pine, and broom pine; in the Middle States as the yellow pine and the pitch pine; and in the Northern States as the southern pine and the red pine. In England it is known as pitch pine, and is generally associated with the place of export, as Darien, Pensacola, Savannah, &c.

It is scarcely necessary to say that its name, "pitch pine," is drawn from the prolific manner in which it furnishes resinous products, a detail in which it has no equal in the vegetable kingdom.

Geography.—The *P. Australis* is a native of the United States, from North Carolina to Florida, abounding in extensive forests near the sea coast. Towards the north it first makes its appearance near Norfolk, in Virginia, where the pine barrens begin.

It seems to be especially assigned to dry, sandy soils, and is found, almost without interruption, in the lower part of the Carolinas, Georgia, and the Floridas, over a tract of more than 600 miles long, from north-east to south-west, and more than 100 miles broad, from the sea towards the mountains of the Carolinas and Georgia. Where it begins to show itself towards the river Nuse it is associated with other trees, but immediately beyond Raleigh it holds almost exclusive possession of the soil.

With few exceptions, notably the scrub oak, this pine forms the unbroken mass of woods which covers this extensive country, and is the only tree capable of existing on this dry, sandy soil.

Captain Hall, in his "Sketches in Canada and the United States," No. xxiii., says:—

"Upwards of 500 miles of our journey lay through these desolate forests, occasional villages gave some relief to the tedium of this part of the journey, and wherever a stream occurred the

fertility of the adjacent lands was more grateful to the eye than I can find words to describe. Once or twice, in travelling through the State of Georgia, we came to high knolls, from which we could look over the vast ocean of trees, stretching without a break in every direction as far as the eye could reach ; and I remember upon one of these occasions thinking that I had never before had a just conception of what the word ' forests ' meant."

The largest specimens of this pine are found in East Florida.

Description.—The *P. Australis*, or pitch pine, is a tree from 60 to 100 feet high, and with a trunk of considerable size, retaining its diameter with very little diminution for two-thirds of its height. The bark is somewhat furrowed, and the epidermis, or outer skin, detaches itself in thin transparent sheets. The leaves are about 1 foot long, of a brilliant green, and collected three in a sheath.

The timber is less associated with sapwood than most species of fir. The concentric circles, in a trunk fully developed, are close, and at equal distances ; and the resinous matter, which is abundant, is more uniformly distributed than in the other species. Hence the wood is stronger, more compact, and more durable ; it is, besides, fine-grained, and susceptible of a high polish. These advantages give it a preference, as a timber tree, over every other American pine, but its quality is modified by the nature of the soil in which it grows.

In the neighbourhood of the sea, where only a thin layer of soil reposes on the sand, it is more resinous than where the soil is four or five inches thick, and the trees which grow upon the first-mentioned soil are called pitch pines, as if they were distinct species. In certain soils its wood contracts a reddish hue, and it is for that reason known in the dockyards of the Northern States by the name of the red pine. Wood of this tint is considered the best, and in the opinion of some shipwrights it is more durable on the sides of vessels, and less liable to injury from worms than oak.

The wood, generally speaking, is of a reddish white colour, clean, hard, rigid, highly resinous, regular and straight in the grain, and, compared with most other pines and firs, is rather more difficult to work ; it is good in quality, and considered to be durable.

This question of durability is in a very unsettled state. There are numerous architects and civil engineers who rigidly adhere to the use of Memel and Danzig fir, and who will not allow the use of pitch pine, whilst there are others who freely use it upon all occasions.

Practical men may be found who maintain that it speedily decays in ground flooring, beam ends in walls, piles, &c., whilst there are others who rank it almost with the oak, and state that in piling, and in jetties, exposed to the tides and weather, it will last double and treble the time allotted to Memel and Danzig fir.

Properties and Uses.—One of the principal uses to which the pitch pine is applied is that of masts and spars for vessels, a purpose in which it has made marvellous headway, although its weight is somewhat against it. So great and general is its use that it has almost extinguished the old Riga and Danzig trade in this useful class of wood.

The longest, cleanest, and straightest logs of pitch pine are selected at the ports of shipment as "mast pieces," and sold at special prices; they range from 100 to 130 cubic feet in contents.

The use of iron and steel masts is interfering with the pitch pine mast trade; but still there is a large number of pitch pine logs used for this purpose at the principal ports of Great Britain.

Next to the oak it is the wood that most enters into church, school, and house fittings, the better or figured specimens finding free use at the hands of the cabinet-maker.

In heavy work it is largely used as beams and planking in vessels, as beams and heavy timbering in buildings, and as pump rods, framework at the pit mouths of collieries, blocks for wood paving, &c.

In America it is largely used, four-fifths of the houses, except the roofs, in Georgia and Florida are built of this wood.

In furnishing resinous products, the pitch pine is the most important tree in the world. The firs of Europe, so long celebrated for their productive powers in this branch, have surrendered at discretion in presence of the pitch pine of the Southern States of America.—*Timber Trades Journal.*

THE AMERICAN SPRUCE FIR.—*Nomenclature.*—This is the *Abies nigra* of our botanists, the black or American spruce fir. It derives its popular name from the dark sombre hue of its foliage, combined, no doubt, with the dark or blackish colour of its bark. This tree is called *epinette noir* and *epinette a la biere* in Canada, double spruce in the district of Maine, and black spruce in Nova Scotia.

Description, &c.—The American spruce fir is a tall tree, attaining in America the height of 70 feet or 80 feet, though the trunk

is seldom more than 1 foot 3 inches to 1 foot 8 inches in diameter. The trunk is smooth, remarkably straight, and diminishes regularly from the base to the summit, which is terminated by an annual lance-like shoot 1 foot or 1 foot 3 inches long. The bark is smooth and blackish. The rate of growth is more rapid than is the case with other spruce firs.

This tree is a native of the coldest regions of North America, but is most abundant in the countries lying between 44 degrees and 53 degrees North latitude, and between 55 degrees and 75 degrees West longitude, *viz.*, in Lower Canada, Newfoundland, New Brunswick, Nova Scotia, the district of Maine, Vermont, and the upper parts of New Hampshire, where it is so abundant as to constitute a third part of the native forests. Further south it is rarely seen, except in cold and humid situations on the top of the Alleghanies. It is sometimes met with in the white cedar swamps near Philadelphia and New York. The finest forests are found in valleys where the soil is black, humid, deep, and covered with a thick bed of moss, and where the trees, though crowded, so as to leave an interval of only 3 feet, or at the most 5 feet, between the trunks, attain their greatest height.

Properties and Uses.—The black spruce, according to Pursh, is of "great mechanical use in America, besides being the tree of which that wholesome beverage called spruce beer is made." Michaux says—"The distinguishing properties of the black spruce are strength, lightness, and elasticity." In the dock yards of the United States the spars are usually of black spruce from the district of Maine; and it is exported in great quantities for the same purpose to the West Indies and Liverpool. The knees of vessels at Boston and in the district of Maine are sometimes made of the base of this tree and one of the principal roots, and it is substituted for oak in many places where the timber of that tree is becoming scarce. It is sometimes used for floors, for which purpose it is found tougher than the white pine (*P. Strobus*), but is more liable to crack. In all these regions, particularly in Maine and New Brunswick, the black spruce is sawn into boards of considerable width, which are sold a fourth cheaper than those of white pine, and are exported in great quantities to the West Indies and to England, being used in the latter country, principally at Birmingham and Manchester, for packing cases. This species is not resinous enough to afford turpentine as an article of commerce, and the wood snaps when burning like that of the chestnut.

Thomas Laslett, in his admirable work, "Timber and Timber Trees," says the white spruce are the only deals shipped to this

country from Canada as a clearly defined class, all others being simply known here as Canadian, St. John's, &c., spruce.

The London market was supplied with about 1,100,000 spruce deals in 1871, 1,080,000 in 1872, 2,000,000 in 1873, and the immense quantity of 2,300,000 pieces in 1874, prepared generally in dimensions of 3 inches thick, 9 inches broad, and 12 to 21 feet in length. The bulk of these were sorted by brackers previous to shipment into 1st, 2nd, and 3rd qualities. Those of the 1st quality are perfectly clean, sound, and free from knots, sap, and defects; the 2nd quality is also sound and tolerably clean, but includes deals with a few knots and sap upon the edges; while the 3rd quality includes and admits all the faulty and coarser descriptions of deals, and some of them are very rough indeed.

The American black spruce is a harder class of wood than the European spruce, and it is more subject to loose knots, which shrink and fall out when converted into boards, flooring, &c. The geographical position occupied by the two classes of spruce influences their use in Great Britain, the Baltic spruce being almost wholly used on the east coast and the Canadian spruce on the west coast, the price of one influencing that of the other. —*Timber Trades Journal.*

THE TIMBER TRADE.—The following is an extract from the "Morning Post":—

So many applications from all parts of the country, for chips from trees felled by Mr. Gladstone, have been received at Hawarden Castle, that the following printed circular has been issued in reply to such requests:—

"In reply to your letter to Mr. Gladstone, I have to say that in consequence of the number of similar requests, it has been found necessary to make in all cases a uniform charge for the wood referred to, *viz.*, 1*s.* 6*d.* for a small log, or 3*s.* per cubic foot. Applications should be made to the Bailiff, Estate office, Hawarden, Mr. Chester, who will attend to any order so far as he may have the required material at hand."

Rhymes for the Times—The Sacred Chips.

Come hither, come hither ye teachers
Of the Gladsto-Hibernian creed,
Ye Radical spouters and preachers
Come hither, come hither with speed;
Parnellite whips, conductors of trips,
Leaders of every grade;

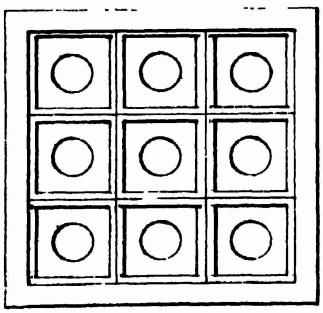
Come press your lips, to the sacred chips
Which fall from our William's blade.
Trunks immense, no false pretence ;
Genuine branch or root,
A nice small log for your eighteen pence,
Or three shillings the cubic foot.

Alas ! for unfortunate dealers
In furniture costly and quaint,
In miracle workers and healers,
In relics of martyr and saint,
Bones will be cheap, nails they may keep ;
Teeth will be simply dross.
With a Gladstone chair, what shrine would care
For a piece of the Holy Cross ?
No fraud or tricks, no common sticks
All tastes we hope to suit
With a nice small log, for one and six,
Or three shillings the cubic foot.

THE BIJNOR THANDA TOKRI.

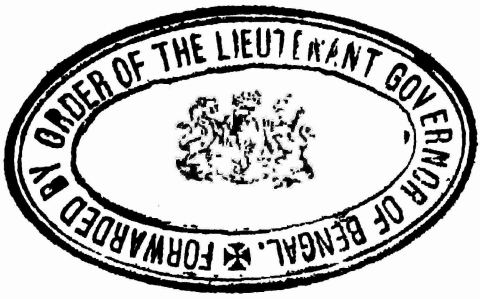
THIS is an invention of the well-known sportsman Mr. Markham, Collector of Bijnor, and any one who has been out with him will gratefully remember the icy cold milk and soda-water with which he regales his guests, in the blazing plains of Bijnor.

Many sportsmen have already copied the pattern of the Thandá Tokri, but one of Mr. Markham's guests, in grateful memory of his cool drinks, and thinking of his brother officers engaged in fire conservancy during the hottest time of the year, has sent us the following description of it, in order to make it more widely known. The annexed diagram shows how the basket should be made, the frame-work being of very open bamboo lattice-work, and lined outside and within with khus-khus, including the lid and bottom.



Each compartment is also thickly lined with khus-khus so as merely to allow room for a bottle.

The basket can be taken on a water-proof or tarpaulin, on the back of an elephant, and is watered from time to time, and keeps the liquor contained in it as cool as if it were iced.



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THE GRAZING QUESTION IN JAUNSAR.

JAUNSAR-BAWAR originally formed part of the Sirmúr or Nahan State. In 1807, it was conquered by the Gurkhas, from whom it was wrested by the British, in 1815. Its area is about 477 square miles, of which about 30 square miles under cultivation support (excluding the station of Chakrata) some 40,000 inhabitants. The parganna is divided into two parts, that near the plains, which is pretty thickly populated, and where bare hill-sides form a prominent feature in the landscape, and the other or northern portion, where the inhabitants are fewer, and where the largest masses of forest are situated. For administrative purposes, it is divided into 39 'khats,' a 'khat' being a collection of village communities, and the unit, in the present land settlement. This division into 'khats' was formally recognised in 1860, and the right of Government to the ownership of all waste land was protected by a rough limitation of the rights of each 'khat' in the waste land included within its boundaries.

In 1865-66, the attention of Government was drawn to the forests by the Inspector-General of Forests, and also by the proposal to establish a Military Cantonment at Chakrata. In settling the forests with regard to villagers' privileges therein, the position of their former compatriots in Sirmúr and their neighbours in Native Garhwál was borne in mind, and the rights of the governing power have been taken as similar to those held in the Native States, rather than determined by a careful study of usages, which had been allowed accidentally to obtain force since our occupation of the country.

Three classes of forests were formed—

1st Class.—Forest areas, in which the rights of Government are absolute.

2nd Class.—Forest areas under the control of Government, but subject to the exercise of certain privileges by the villagers.

3rd Class.—Forest, or waste land, made over in full proprietary right to the different khats barring the right to sell forest produce.

The first class calls for no explanation. The second class, which embraces by far the greater part of the Government forests, was considered necessary, from the inhabitants in one way or another having had the free run of the whole forest area since our rule began. The third class was formed for land which, from its vicinity to cultivation, it was inadvisable, or useless, to place under the immediate control of Government, and in which a permanent increase to existing cultivation was hoped for. Later on, large tracts of precipitous ground, entirely or nearly bare of forest, were also included in this area, and the whole was made over in full proprietary right to the villagers in 1873, as compensation for the more definite limitation of their privileges in the Government forests. The demarcation of the forests had, therefore, to be taken up 'khat' by 'khat' and not as a whole. After the examination of a 'khat' two points had to be decided—

1*st*. If there was waste land of sufficient area to warrant the reservation of a portion as Government forest.

2*nd*. If that area was large enough to admit of any of its being placed in the first class.

For example, in selecting a second class forest in a khat containing some two or three square miles of oak forest interspersed with cultivation, and in which nearly all the trees were lopped for fodder, save under exceptional circumstances, no area was marked off as Government forest.

The villagers have general grazing privileges in the second class forests of their khats, and in certain specified instances, in similar forests of other khats, but the Forest officer, with the sanction of the Superintendent of the Dun, has the power of closing some of these forests until reproduction is ensured. The villagers are responsible for any fires which may occur in second class forests, protected from fire, but open to grazing, and should a fire, take place and they cannot prove that it was caused by villagers of another khat, they are liable to fine. The responsibility of protecting the forests against the straying of cattle, when going in exercise of any right through 1st class or closed 2nd class forests to water,

cultivation or grazing areas, rests with the Forest Department, as does also the responsibility of fencing those portions of forest which run into the village cultivation, so as to render it difficult for the villagers not to prevent the trespass of cattle.

In fixing the land revenue under the late settlement, cows, bullocks and buffaloes were assessed at one anna per head, sheep and goats at a quarter of an anna each. None of this revenue is credited to 'Forests,' though the animals chiefly graze in the 2nd class forests. The domestic cattle are of the small black and red short-legged breed found throughout the hills, and are inferior to the plain's cattle in size, strength, and as milch animals. The sheep on the contrary, are superior to those in the plains, and produce excellent mutton. Both have increased very considerably of late, and from the following statistics it does not seem as if forest conservancy had too greatly constricted the grazing area.

Year.	Number of horned cattle.	Number of sheep and goats.
1850, ...	10,870	27,200
1860, ...	32,300	50,100
1883, ...	35,270	54,860

The largest areas of closed forests are in the Deoban range, which has to supply timber and fuel of Chakrata. If we analyse the accompanying list of cattle in the different khats of this range, we find that in spite of the areas which have been closed, those khats, where both open and closed Government forests exist, are still best off for pasture.

List of Cattle in the Jaunsár khats of the Deoban range.

No.	Name of khat.	Cows.	Bullocks.	Buffaloes.	Sheep.	Goats.	Number of grazing units.	Grazing area including waste land and open Government forests.	Number of acres per grazing unit.	No. of grazing units per adult cultivator.
1	Haripúr Bias,	130	109	30	25	22	794	1,913	2·4	..
2	Pánjgaon, ..	750	610	41	437	868	4,910	6,853	1·4	17·8
3	Bána, ..	319	307	..	228	773	2,566	3,636	1·4	13·1
4	Leli Gothan,	544	488	14	368	715	3,733	4,206	1·1	10·9
5	Leli, ..	1,218	1,026	48	923	1,292	8,065	8,746	1·0	13·2
6	Koru, ..	547	867	73	297	724	4,921	5,085	1·0	9·4
	Carried over,	3,508	3,407	206	2,278	4,394	24,989	30,439	1·4	10·7

List of Cattle in the Jaunsár khats of the Deoban range—(continued).

No.	Name of khat.	Cows.	Bullocks.	Buffaloes.	Sheep.	Goats.	Number of grazing units.	Grazing area including waste land and open Government forests.	Number of acres per grazing unit	No. of grazing units per adult cultivator.
	Brought forward,	3,508	3,407	206	2,278	4,394	24,989	30,439	1·4	10 7
7	Lilgaon, ..	1,096	527	..	671	1,777	6,505	5,915	0 9	
†8	Semalta, ..	316	312	..	233	259	2,062	1,914	0 9	
†9	Athgaon-Chandu, ..	347	200	..	199	620	2,186	3,291	1 5	Figures not available
†10	Bangaon, ..	1,015	357	27	324	1,263	5,152	7,085	1 4	
†11	Udpálta, ..	335	383	4	129	454	2,398	2,156	0·9	
†12	Birman, ..	683	311	12	329	525	3,899	2,299	0 7	
*13	Bamtár, ..	777	901	..	648	1,231	6,074	9,488	1 6	11 3
*14	Mohna, ..	444	250	..	488	544	2,767	4,244	1·5	20 8
*15	Dwár, ..	467	225	21	637	729	3,201	6,429	2·0	24·4
*16	Bislár, ..	1,038	327	19	1,167	1,332	5,956	8,032	1 3	25 3
*17	Kailo, ..	537	277	..	808	828	3,671	7,684	2 1	23 4
*18	Missan, ..	483	402	..	1,660	1,827	5,699	7,360	1 3	20 9
19	Bharam, ..	450	510	..	1,500	2,000	5,900	13,490	2·3	10 7
*20	Dhanan, ..	557	321	..	1,761	1 684	5,640	8,188	1 5	19·3
†21	Dissan, ..	752	452	..	684	1,623	5,317	8,249	1 6	13·9
	Total and averages,	12,805	9.162	289	13,516	21,090	90,916	1,26,263	1·4	16·7

* In these khats, there is closed Government forest.
† In these khats, there is no Government forest.

N.B.—A grazing unit is a sheep or a goat.

1 Buffalo = 5 sheep.

1 Bullock or cow = 2·5 sheep.

From the above figures the following may be deduced :—

Khats with	Number of acres of waste land and open Government forest per grazing unit.	Number of grazing units per adult cultivator.
No Government forest,	1·2	not known.
Open „ „ only,	1·3	12·5
Open and closed Government forests, ...	1·6	20·8

This points to the fact that, the grazing area where the great mass of the forests exists, is extensive compared to the number of cattle, sheep and goats accustomed to browse over it, and that no hardship has been inflicted on the people by closing portions for the purpose of reproduction, as their grazing grounds are still larger than those of the other khats. The grazing unit has been adopted from Mr. Whittall's calculations in the last Annual Forest Report for Oudh, and is based on the supposition that a buffalo eats 10 seers of fodder, a cow or bullock 5 seers, and a sheep or goat 2 seers per diem.

According to the present land settlement all the animals in the above list are entitled to free grazing in the open Government forests, but in reality only those villages nearest the forest graze their cows and bullocks in them, and a considerable proportion of the goats never leave the zamindári lands, although most of the sheep are brought to the high level grazing grounds in the forests from June to October. It seems, therefore, to point to a lack of appreciation of the importance of confining grazing in valuable Government forests to the actual requirements of the district, when privileges are granted to villagers, who do not require and never use them. Such an example almost suffices to show the importance of making a final enquiry into the interests of the inhabitants in these forests, and of definitely settling their privileges under the Forest Act.

Most of the forests included in the Deoban range lie to the north of Chakráta, and vary in altitude from 5,000 to 10,075 feet, whilst to the south of the station there are a few outlying bán oak forests. There are large areas of precipitous and rocky ground, especially at more or less southerly aspects, and the gradient usually varies between 30° and 45° and over, but gentler slopes of from 15° to 30° are occasionally met with. The gradients of the outlying oak forests vary from 15° to 45°. The principal types of forest are those of deodar, kail, fir, oak and chir.

To get a general idea of the effects of grazing on these forests, it will be useful to compare the number of III., IV. and V. class trees with those of the I. and II. classes, the two latter classes together representing unity.

Kind of tree.	Forests closed to fires and grazing.			Forests closed to fires only.			Forests open to fires and grazing.		
	Diameter Classes.			Diameter Classes.			Diameter Classes.		
	V. 3″—6″	IV. 6″—12″	III. 12″—18″	V. 3″—6″	IV. 6″—12″	III. 12″—18″	V. 3″—6″	IV. 6″—12″	III. 12″—18″
Deodar, ..	7·5	4·0	0·9	4·2	1·8	0·7	No forests open to fires and grazing.		
Kail, ..	20·2	4·8	1·1	8·2	2·5	1·0	1·0	1·0	0·9
Chir, ..	No forests closed to grazing.			6·5	2·0	0·7	0·4	0·7	0·6
Firs, ..	4·9	2·5	1·1	6·1	3·0	1·2	No forests open to fires and grazing		
Bán oak, ..	2·7	2 7	1·0	2·0	2·4	1·1	0 7	1·4	1·0
Ayár & Buráns,	12 0	10 0	1·8	8·7	9·1	2·0	10·9	11·9	3·2
Kokat, ..	39 6	15 6	2·2	29·0	12·4	2·6	19 1	11·7	2·8

Kail = *Pinus excelsa.* | Buráns = *Rhododendron arboreum.*
Chir = „ *longifolia.* | Firs = *Abies Smithiana* and *Pindrow.*
Ayár = *Pieris ovalifolia.* | Kokat = Miscellaneous species.

It will be observed that the forests open to fires and grazing are sadly deteriorating, since the number of V. class trees ought almost always greatly to exceed the number of I. and II. class ones, in irregular forests, such as we are here dealing with. The only exception is in the number of young ayár and buráns, but these almost worthless species, which never reach large dimensions, are always associated with bán oak, and it would seem as if, under the *régime* of fires and grazing, they were usurping the place of the valuable oak, whose reproduction is so backward.

In the forests closed to fires only, reproduction is not so good as in those closed to grazing as well, with the solitary exception of the firs. The reason for this exception is doubtless the fact that all the closed fir forests are at high altitudes and at cold aspects, where reproduction becomes difficult and seed years rare, whereas the open fir forests are lower down, many of them being below 8,500 feet.

The excellent remarks in the April Number of the "Indian Forester" on the irregular way in which the Berar forests are grazed apply with even greater force to those of Jaunsár. Here the cows and bullocks graze all the year round within a few miles of the village, as do also nearly all the goats, for the latter can stand being housed, and thus furnish valuable manure for the various grain crops. The sheep on the contrary are constantly on the move; all the sheep of one khat usually grazing together. They go down in the winter to the bottom of the valleys below the snow, and in the summer, are brought up to the high level pasture lands between 8,000 and 10,000 feet, where they remain from June to October, being taken back to the villages once for shearing purposes. Throughout the forests, there are regular halting places for these flocks, called 'taches.' They are open grassy blanks with gentle slopes, surrounded by small pillars of loose stones, on which the shepherds light fires at night to ward off wild animals.

There are, therefore, numerous congested grazing centres scattered throughout the open forests immediately around the 'taches,' and other heavily grazed areas, in close proximity to the villages, whilst elsewhere, there are considerable areas where the grazing is very slight or almost nil, the latter being the case on very precipitous ground, or on less steep slopes remote from water, or to which access is difficult. It has been observed that along a road leading to water, or to grazing grounds, the slopes above are often full of seedlings, whilst those below contain scarcely any, the explanation being that the flocks in going and coming do not climb up the steep banks, but almost invariably graze along the more accessible slopes below the path.

In the kail and deodar zone, reproduction is so vigorous that it is only near 'taches' and other heavily grazed places, or near the upper limit of the species that, we need fear for the future of the forest. In such localities, there are numerous grassy blanks, so closely cropped that, the grass forms a dense turf, reminding one of English downs. Here the scattered kail and deodar seedlings are much browsed down, remaining for years in the form of bushes, their branches spreading along the ground until perhaps the centre is beyond the reach of a goat, when a strong leading shoot is sent up. Over the more lightly grazed areas, reproduction is greatly checked, as is proved by the figures in the preceding pages, but the future of the forest is safe, although its potential yield is decidedly lessened.

There are no chir areas protected from grazing in the range, but the benefits of fire protection are more marked with chir, than with any other species, excepting perhaps kail, and the small chir area in the Raura block, which has been successfully fire-protected since 1872, is well worthy of a visit, and contrasts most favorably with the burnt forests which surround it. Now that the number of grazing animals to be admitted to the chir forests has been limited, it is hoped that, thanks to the wonderful reproductive powers of this pine, closing to fires alone will assure the maintenance of the forests, and that it will probably never be necessary to close the bulk of these forests to grazing, provided that fires can be kept out with the aid of the graziers themselves, although of course there will be small heavily grazed areas which may have to be closed for a time.

In the oak forests, we are confronted with an important question intimately connected with the grazing one, *viz.*, that of lopping the trees for fodder and for manure. However destructive indiscriminate grazing may be in a coniferous forest, it is still more dangerous amongst the oaks, for goats like nothing better than succulent oak leaves. The result is that, as regards the bán oak, reproduction is very backward in the open forests, and many of the young plants which do exist are misshapen and badly grown, and are frequently reduced to mere bushes by the persistent nibbling of the goats. Nearly all these bán oak forests are close to villages, and thus grazing goes on in them all the year round, whilst in the winter, the trees are excessively lopped for fodder, and the state of some of them in consequence leaves much to be desired. In the open part of Kurwa, where lopping has been continuously practised both for fodder and for manure, no trees were allowed to get above 15 feet high, and the area has been completely ruined. The

rules are, that no trees under 3 feet in girth are to be lopped, nor branches or twigs over one inch in diameter, and that the leading shoot is to be left intact, but the villagers have not observed these rules, and Kurwa is to be closed as a warning. They have been cautioned that if they persist in disobeying orders, the privilege will be withdrawn altogether. There are some similar rules for the third class forests, which are under the sole control of the civil authorities, but no attempt has apparently even been made to enforce them, and they remain a dead letter.

The present constitution of the forests as given below shows how they have suffered in the past from the combined effects of fire and grazing. The figures given are, however, subject to correction.

Stocked with forest.	Plantations.	Blanks filling up with natural reproduction.	Blanks suitable for planting.	Unproductive areas.	Chaks of cultivation.	Total.
Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
13,234	678	1,167	3,563	3,062	464	22,168

Thus when the forests were taken over by the Forest Department, nearly a fourth part of the ground perfectly suitable to good forest growth consisted of grassy blanks, and of this area, one-third, mostly in the closed forests, has been already covered with natural and artificial seedlings.

N. H.

RING-BARKING IN AUSTRALIA.

An interesting correspondence has taken place in the Melbourne "Argus" regarding the practice of *ring-barking* in Australia, which is extensively followed by graziers.

Dr. Andrew Ross, M. P., in New South Wales, considers ring-barking as a crime against the best interests of the Colony, and though he admits that grass vegetation becomes much more abundant after the trees have been ringed, yet he states that this grass is coarse, rank and indigestible, and deficient in chlorophyll and "*other nutritious elements.*"

The Melbourne "Argus" does not profess to know much about chlorophyll, nor about the laws of physiology and animal economy, but predicts ruin to the man who attempts to live by stock-keeping on 50,000 acres of ordinary unrung forest, while it is con-

fident that, fat sheep and fair clips are tolerably sure when once the trees are killed and the nutriment they might have absorbed is sent on to the grass.

It is a pity that the elements of vegetable physiology are not studied by Australian farmers and newspaper editors, and especially that the latter, who hold out the torch of knowledge in such a wealthy and populous city as Melbourne, should trust to their own natural shrewdness rather than to their scientific acquirements. After the outcry of Professor Huxley in the "Nineteenth Century," and of Mr. Goschen at Aberdeen, it is time for Anglo-Saxons all over the world to give up the system of learning truths merely by suffering from the disastrous consequences of neglecting them, and to endeavour to profit by the wide field of experience of others, which is now so richly offered by science, and in which Germany has taken such a decided lead.

But though the Editor of the Melbourne "Argus" may consider that the comparatively deep-rooted Australian trees deprive surface-feeding grass of its proper nutriment, and though Dr. Andrew Ross considers chlorophyll as the green juice of grass, which is much richer and more nutritious under the shade of trees, than in the open; both these gentlemen are actuated by the lofty desire to benefit their country, and their bold display of ignorance of the elementary truths of vegetable physiology in support of their opinions has a certain merit, as there is much to be said for the conclusions arrived at by both of them.

Dr. Andrew Ross's real contention is that, forests are essential for the well-being of a country, that, it is inhuman and cruel to condemn stock to live through blazing Australian summers on shadeless wastes, and that, forest destruction affects the rainfall and the discharge of rivers and the permanent timber supply of the country.

The Editor of the "Argus" entirely agrees with Dr. Ross on the necessity for the preservation of tracts of forest, such as those on the Otway ranges, which should act as a sponge for absorbing the abundant rainfall and the slow and continuous feeding of several valuable rivers, but he rightly considers that too much shade is prejudicial to grazing grounds, and argues for the destruction of stunted scattered box trees, and the clearing of land encumbered with them for grazing and agriculture.

Light is unquestionably essential for the formation of starch in the green parts of plants, and unless these contain plenty of starch, sugar and other nutritious compounds, grazing animals cannot be expected to thrive.

We should by all means allow small groves to remain here and there on grazing grounds, under which cattle can rest during the heat of the day, but the rest of the ground must be cleared of tree growth, if the grass is to be strong and really nutritious.

Of late, there have been attempts made by agricultural authorities in India to induce Government to open forest lands much more liberally to grazing, but in our opinion, grazing is best on cleared lands, and the maintenance of forests is incompatible with heavy grazing.

Grazing and forest lands should be gradually separated, and in forests intended to be maintained for the production of timber, the regulation of grazing should be left entirely to the Forest officer, whilst in grazing grounds, the sooner the tree growth, with the exception of what is required to shade cattle during the heat of the day, is cleared off, the better will be the grazing afforded.

The Melbourne "Argus" is clearly in favor of scientific forestry in Australia, as the following quotation shows :—

"There should be in each colony an educated forestry department, with competent local authority to enforce its decrees, and the permission of this department should always be obtained before any lessee of Crown lands is at liberty to begin on the wholesale destruction of the native timber. The necessity of planting on natural treeless plains, or in localities where an undesirable work of denudation has already been effected, is a matter which admits of no argument, and should have been tackled in practical fashion long ago."

Mr. Vincent of the Madras Forest Department lately wrote a report on the forests of Victoria, but the Minister of Lands has apparently not thought it advisable to publish this report, which we should be very glad to see. In a subsequent number of the "Argus" a champion of forestry has arisen, and his letter on the subject is so much to the point that we print it *in extenso*, and it is to be hoped that the Australian Statesmen will not sit down and talk about the benefits of forestry while their forests are disappearing, as they do in the United States and Canada, or start a Forest Department and then abolish it as an expensive luxury, as had just been done by the wiseacres who govern New Zealand.

"In a leading article in 'The Argus' of yesterday you quoted a statement by Dr. Andrew Ross on the effect produced on grass by the ringing of forest land. Dr. Ross is, I think, a little shaky in his vegetable physiology, or he would not refer to chlorophyll as a 'juice,' nor would he declare it to be 'so abundantly rich in all verdant grass and vegetation in an unrung country.' Chlorophyll is found in the form of granules,

and consists of two parts, *viz.*, the granule and a certain green colouring matter. The latter portion depends for its existence on the access of light, which has also the further effect of causing the chlorophyll granules to develop grains of starch. Arguing from these well-known facts, it appears to me that grass and other herbage which has grown under the shade of a forest is less likely to contain nutritious food than those plants which have developed under the more favourable conditions of light produced by ringing, and so killing, the trees above them. It is, however, I believe, universally acknowledged that forest growth has a beneficial effect on soil. The leaves, dead twigs, and fruits of forest trees falling on the ground year after year, and gradually decaying, form a soil or humus most valuable for vegetable growth; while the shade afforded by the leaf canopy keeps this soil cool and moist, prevents the destructive effects of sun-heat, and breaks the force of too heavy rain. The only reason why herbage does not thrive under a forest is simply insufficiency of light, and ringing the trees at once supplies this want.

"It would appear, then, that both theory and practice show ringing to be decidedly beneficial, if the object be simply to produce an increased growth of grass. But the further question as to the extent to which ringing should be carried on is a much wider one, and not quite so easily argued. Certainly nothing has yet been proved as to the way in which rainfall is affected by forests or by their removal. Nevertheless, dense forests and plentiful rains are usually found together, and the experience of the Cape Colony, where the disappearance of forests, owing to excessive felling, fires, and grazing, has been followed by severe droughts, is, at any rate, a significant fact, difficult to explain on any other hypothesis than that the trees were the cause, and the moisture the effect. As to the influence of woodland on the discharge of rivers, however, the evidence is much clearer, and, I may even say, conclusive. The disastrous consequences which followed the deforesting of the Alpes Maritimes, and the enormous expense in masonry, dams, and in works to again afforest the bare slopes, form an example of a striking character, which most readily occurs to one. I do not deny that this example is, perhaps, of rather a special nature, since the forests were situated on crumbling shale, which was really held up by little more than the roots of the trees growing on it, and as soon as these were removed the heavy rain, brought by the moist winds from the Mediterranean, rapidly produced torrents of terrific dimensions. But besides this other examples of less magnitude, though equally convincing, have frequently been quoted. I mean, for instance, such cases as streams having become so irregular in consequence of the removal of forests along their banks as to be useless for turning water-mills, where formerly the wheels were worked without inconvenience, while the mills again came into service when the forests had been allowed to grow up once more.

"It would be a most dangerous thing for public opinion in the colonies to consider that generally forest land is waste land; that all timber required can be easily imported—and of kinds far superior to indigenous sorts; and that the more timber cleared the better for agricultural and pastoral pursuits. There is yet time in Victoria to deal with this matter. Let competent experts decide what proportion of wooded to open country is necessary for the good of the community, and then let Government mark out forest reserves to that extent from the areas of crown lands still undisposed of. I am aware that a forest bill is to be presented to Parliament at the next session, and, until the provisions of this measure are known, it would be premature to discuss it. It seems to me, however, that the importance of Victorian forests is sadly underrated when the official who is to guide what should be a small State department is only to receive £650 per annum. The forest area of this colony is quite big enough and quite valuable enough to give ample work for one Conservator on at least £1,000, aided by three competent assistants on about £500 each. I am of opinion that the Government does not quite realise what a handsome return may be obtained financially from well-managed State forests, while at the same time ensuring the well-being and permanency of the latter. Should such proposals as these ever be carried out, where will the Victorian Government apply for competent officers? The science of forestry requires as much special knowledge and as much special training as any other profession, or employment of a technical nature. In Germany, in France, and in India, where are to be found the three greatest forest departments in the world, all superior officers, before obtaining their appointments, have to go through several years' training at special forest schools, while many of the subordinate officers have also to pass through a course of instruction in schools of less elevated standard. Why should not Victoria also send men to be trained for her superior appointments under the Conservator? The recently established courses of forestry at Cooper's hill would exactly suit the requirements of the case, and the expenses of travelling and maintenance ought not to be too much for the object to be attained. For minor appointments much elementary teaching of the most useful sort could be arranged at Dookie with very little extra expense. However the Government may now regard the matter, I have little doubt that the Conservator they may eventually appoint will, sooner or later, urge upon them the necessity of some such course as that I am now advocating. Fancy a man at the head of a magnificent charge obliged to leave the practical execution of his ideas to subordinates whom he knows to be untrained, unskilled, and worse still, perhaps filled with the bigoted ideas of ignorance—which is really the true term for many an uneducated man's 'practical experience.'—M. H. C.

Melbourne, March 22nd.

RESIN PRODUCTION IN THE JAUNSAR FORESTS.

As already noticed in the "Indian Forester," trials for ascertaining the yield of resin were commenced in the years 1884-85 with 20 chir trees (*Pinus longifolia*) at Darmigád in the Bawar Range of the Jaunsar Forest Division, School Circle.

The spot is about 3,800 feet above the sea. The hill men's method was followed. Two cuts were made through the sapwood, and reservoirs were cut out in the wood itself for the accumulation of the resin. The following was the yield per tree :—

in the 1st year 3·6 seers or 7·4 lbs.
in the 2nd year 2·4 seers or 4·9 lbs.
in the 3rd year 2·2 seers or 4·5 lbs.

A mistake occurred in the previous notice of this experiment in the "Indian Forester" for March 1888. The pounds there given are really so many seers.

The trees show up to date no signs of decay, and tapping is continued.

The experiment has now been commenced on a larger scale. In the beginning of May trees were tapped as follows near Kathián in the Bawar Range, Jaunsar Division, School Circle :—

Level above the sea.	Distance from Kathián.	Number of trees tapped.	Species.
6,900 feet,	2 miles	500	*Pinus excelsa.*
5,700 ,,	2 ,,	900	,, *longifolia.*
3,800 ,,	4 ,,	100	,, *longifolia.*

The last place is in the valley called Darmigád, which meets the Tons river on the left. The aspect of all places is east.

The tapping was done in the following manner:—After removing the bark over a sufficient surface, an oval cutting was made into the sapwood about a foot from the ground, 10 inches high and 6 inches wide. At the upper end the cutting is 3 inches deep, and the depth gradually lessens from the top downwards, so that at the lower end it joins smoothly with the surface of the stem. This makes it easy to apply the curved chisel of 5 inches width of French pattern. It produces a slit, into which a bent plate of metal is inserted, so as to form a slightly inclined rim, over which the resin flows into a vessel which is hung externally to the tree. The vessels are conical, and hold one pound of liquid resin when full. Some of the vessels are of galvanized iron and some of burnt clay. The latter cost only one-fifth of the metal ones. After the clay vessels had been fixed to the trees there was no more breakage,

and they were as good as the metal ones. Only clay vessels will therefore be used in future.

As far as could be seen at the commencement of the tapping operation, the *Pinus excelsa* gave a far more valuable resin than the *Pinus longifolia*. The trees had, as a rule, two cuttings each, and some yielded half-a-pound in each vessel during the first 24 hours. The resin was as liquid as oil and very clear. The product of *Pinus longifolia* was much less liquid, only of the consistency of syrup. The yield of the *Pinus longifolia* was small at the commencement, but an improvement is expected in June, when the temperature will be higher. Both species showed very great difference in the yield of individual trees. Some trees yielded very well, whilst some produced next to nothing, without any apparent reason, except that in some cases of small yield the sapwood was thin. The trees were on an average of 2 feet diameter and more. The upper edges of the cuttings will from time to time be freshened up, and the cuttings thus gradually raised up the stem, the vessels following.

Samples of the two kinds of resin will be subjected to distillation to ascertain the proportion of dry resin, or colophony, and oil of turpentine. But it is expected that the *Pinus excelsa* resin will be utilized in the crude form for varnishes, &c. Some very liquid crude resin of *Pinus excelsa* was sent to Messrs. Gillanders, Arbuthnot and Co., Clive Street, Calcutta, for opinion as to its commercial value.

H. W.

RECLAMATION OF USAR LAND IN BEHAR.

With reference to the extract from the annual report of the Agricultural Department, Bengal, for 1886-87, under the above heading in the "Forester" for March, it may be well to call the attention of your readers to the fact that it is not clear that the experiments described were performed on true 'usar' land at all. Certainly Mr. Maries is not reported to have said so in the extract given. Those of the readers of the "Forester" who do not know the nature of 'usar' land might be recommended to peruse the *Remarks on Saline Efflorescence on certain lands in Upper India*, by Lieut. J. F. Pogson, contained in Vol. III., N. S. of "Jour. Agri. Hort. Soc. of India," Part II., page 37, *et seq.*

The probability is that the land in Behar referred to is not 'usar' soil but 'reh' land, a very different matter; and this is worth bearing in mind, when there is any thought of reclaiming

saline soil. It is indeed not unusual, though it is incorrect, to speak of 'usar' soil as 'reh' land. This is generally, because of the human tendency to make the most of the matter in hand; the same tendency acting in the opposite direction in this instance makes 'reh' land be spoken of as 'usar.'

Mr. Maries' results are extremely interesting, more especially as all who know him will rely upon his facts. But it can only be by analysis after a longthened period of cultivation that any conclusion can be come to as to the changes effected in the soil. If improvement does take place, the explanation may with some degree of safety be looked for in the physical conditions resulting from afforestation, not in any *wholesale** absorption of salts by the trees. It is easy for instance to see how, under such conditions, the efflorescent incrustation should disappear, and it ought to be no cause for surprise should a little difference be produced in the chemical nature of the soil after a long series of years. There can, however, be no question as to the advisability of cultivating the Rain tree in such districts. The amenity of the region will not fail to be increased, and the plentiful crop of sweet pulpy pods, greedily eaten by cattle, and ripening in April and May, when fodder is most scarce, which *Pithecolobium Saman* produces, will form an item of some value. At the same time it should be remembered that while the Rain tree is at home in Lower Bengal, and thrives well in Madras, the *précis* of the reports on its cultivation in Bombay, which is published in Vol. VII., N. S. of "Jour. Agri. Hort. Soc. of India, Part II., page 68, *et seq.*, is not altogether of a favorable tenor, and it has yet to be shown that the climate of Upper India will suit it.

D. P.

COMPOUNDING FOREST OFFENCES.

THERE has recently been a good deal of correspondence in your columns concerning compounding forest offences, and much—if I may be allowed to express an opinion—unnecessary objection taken to the practice. As a matter of fact, any Forest officer in charge of a Division, in which much produce is removed by purchasers, will agree with me in feeling that, without the section of the Act in

* It is certainly true that some of the salts will be absorbed by the roots, and equally true that more salts will be absorbed by a rapidly growing species like *Pithecolobium Saman* than by more slowly growing species. But a wholesale absorption is not to be looked for, and all prediction should be suspended till exact analyses of the soil before and after cultivation are available.

question, the control of our forests would either be impossible, or, would cost such a fortune in establishment as to do away with any chance of a surplus revenue.

A little reading of the Forest Act, despite its somewhat ambiguous clauses, will soon put a Divisional officer into the way of settling petty cases without reference to a Magistrate, and of so recording enquiry as to secure a conviction when the offender refuses to compound and it is necessary to take the case into court.

The method followed by me is this. The original reporter of a forest offence is generally the guard in charge of a beat. He reports the matter to his Ranger on a printed abstract, sending one copy to the Magistrate of the circle (see further on for explanation of this action). In this abstract he gives the names and addresses of the offender and witnesses, nature of offence, &c. The Ranger then enquires into the offence, recording the witnesses' statements as well as that of the accused. Each statement is signed by the witness or offender, and if the latter chooses to give in a written admission of his offence, this is attested by two respectable witnesses, in whose presence the offender admitted his offence, and where the parties are unable to write, their marks are attested.

This report is sent to the Divisional officer who, going over the record, fixes the compensation he will accept, and returns the record through the Magistrate to whom the duplicate report was originally made, to the Ranger, who proceeds to demand the compensation.

This procedure does away as far as possible with any opportunity for extortion, for the enquiry must take place before two or more respectable persons not connected with the Department. A Divisional officer of any experience can almost always tell whether a case is an honest one or not, and a rigid adherence to the requirement from one's subordinates of clear and independent evidence to the offence will save the Divisional officer from giving improper orders. I have settled, literally, thousands of cases on this method, and have had to prosecute but a fractional percentage, while the refusals to compound, appeals against enquiries, &c., have been *very* few. Indeed my whole endeavour is, in these matters, to have the record so complete as to render any appeal to the Deputy Commissioner, as head of the Executive, or any objection on the part of the offender, of no avail. Another result of a little care in preparing the record is, that the proportion of convictions in those cases which are taken before a Magistrate is very high. This success is only obtained by the Divisional officer unmercifully

throwing out reports from his men, which are not completely supported by evidence.

With regard to the sending a copy of report of offence to the Magistrate, the question was raised by the then Commissioner of Jubbulpore some years ago. He pointed out that by Section 52 of the Forest Act every seizure must be reported to a Magistrate, but that, for the Magistrate to interfere in every case under Section 53, would be to render Section 67 of no use. He therefore directed that, a report should be made to the Magistrate (in our Provinces the Tahsildar), and the Magistrate would hold back any further action till the Divisional Forest officer had decided to demand compensation. By the Magistrate being made the means of communication with the Ranger, he is kept informed of the Divisional officer's action. The procedure meets the requirements of the Act, and at the same time, does not cause any unnecessary delay.

In your April Number, you say that the Divisional officer in the North-West Provinces himself enquires into every forest offence, but in the Central Provinces this would be impossible. In the first place, the Divisions are of such enormous size, and secondly, the forests are, as a rule, much intermixed with malguzari forest, which is the cause of the great number of petty offences, to enquire into which would take up the Divisional officer's time completely to the exclusion of every other kind of work. I fancy the forests in the North-West Provinces are more compact, for the Central Provinces Divisional officer would indeed rejoice in a state of things in which he had no more than a radius of 20 miles to go to reach the limits of his charge.

GORARH.

COMPOUNDING FOREST OFFENCES.

AN explanation on the size of forest divisions and charges would probably have saved a good deal of correspondence that has lately taken place on the subject of "Compounding Forest Offences." The Editor in the April Number states that a radius of 20 miles from head-quarters is the usual size of a division "up-country," whereas in other parts of India, a distance of 60 to 70 miles north and south of head-quarters is not an uncommon case, *i.e.*, one has to march a direct distance of over 120 miles to get at the limits of the forests in his charge. If "Ghati" had to travel over a division of these dimensions, he would find that the settling

of forest cases in court—of course I mean as a rule trivial cases —a great waste and delay of time, not to mention the injury that might take place in forests that would be left unguarded pending the settlement of such cases in court.

Also there is another important point that should be kept in view when arguing this question, namely, the status of the forests. What heavy offences—excepting grazing—could take place in such waste land areas, *e.g.*, in Berár, as described by "E. P. D." in this April Number of the "Forester;" the thefts would chiefly be of grass, fuel, and fencing material.

13th March, 1888. A. J. C.

DEHRA DUN FISHING ASSOCIATION.

THE following is the text of the Memorial recently submitted to the Local Government:—

We the undersigned members of the Committee of Management, Dehra Dún Fishing Association, respectfully beg to invite the attention of His Honor the Lieutenant Governor and Chief Commissioner, to the necessity which exists for the preservation of Fish in the rivers and streams of these Provinces.

The initiative in this matter has been taken by the North Punjab Fishing Club, and a memorial was forwarded by them to the Punjab Government in June of last year. A copy of this memorial, together with the replies received, is herewith attached for information.

The points which the Dehra Dún Fishing Association humbly desire to bring to the notice of Government are—

Firstly.—That great local and general interest is taken in the preservation of fish, as evidenced by the fact that the Association, although formed only in June last, already numbers over 75 members residing in Northern India generally. The formation of the Association was brought to the notice of the late Lieutenant Governor, Sir Alfred Lyall, and a favorable reply was received from his Private Secretary; a copy of this is attached.

Secondly.—Within the last ten years fish have markedly decreased in both the large and small streams of these Provinces.

Thirdly.—That legislation is absolutely necessary, because there is at present no check whatever on the destruction of fish by means which in other countries are considered illegal and illegitimate. Netting is carried on night and day. Streams are turned and dammed with the inevitable result that not even can the small fry

escape. The direct and indirect loss to the people at large in the matter of fish food is thus simply incalculable.

Fourthly.—That where the streams are not interfered with except as regards rod fishing, *e.g.*, where they traverse Government forests, they are plentifully stocked with fish of all sizes. This fact is patent even to a casual observer.

We earnestly hope that His Honor the Lieutenant Governor will be pleased to bring the above-mentioned facts to notice of the the Government of India, and in case it should be deemed advisable to pass a Fishery Act, we humbly beg to offer the following suggestions with regard to these Provinces :—

1. That a close season for netting, *viz.*, from the 15th June to the 15th October in each year, should be established.

2. That the use of nets, the meshes of which are less than two inches square, should be prohibited.

3. That no single part of a river, or stream, should be netted more than once in the twenty-four hours.

4. That the use of two series of nets one behind the other in immediate succession should be prohibited.

5. That damming, or turning aside a stream, for the purpose of catching fish should be prohibited.

6. That no explosives of any kind whatsoever, nor any poison should be allowed.

7. That no netting whatever at any time or season should be permitted in the larger streams, such as the Ganges and Jumna, within a distance extending from one quarter of a mile above the highest mouth to one mile below the lowest mouth of "spawning" tributaries.

8. That Fish-ladders on Colonel Macdonald's (?) Plan (a model of this has been sent for by a member of the Association who has seen it in use and can vouch for its efficiency) should be introduced into the "bunds" of the larger rivers wherever necessary, *e. g.*, in the headworks of the Ganges and Jumna Canals. The existing Fish-ladders of Maiapur and Narora only allow small fish up to two pounds weight to pass.

9. That rod-fishing be permitted in all streams and at all seasons.

Captain A. W. Hearsey, who attended the Delhi Conference as our representative, reports that he was permitted to join in the discussion on various matters through the courtesy of the President, Sir E. Buck, and that it was considered necessary to legislate at once on the following points :—

1, Dynamite; 2, Poisoning; 3, Fixed Engines; and with regard to certain points, *viz.*, 1, Weirs; 2, Bunds; 3, Fish-ladders; 4, Stock pools in rivers, and 5, Canal reservoirs, it was thought better to obtain more ample information before legislating on these matters.

Captain Hearsey made some suggestions regarding Canal reservoirs, which were favourably considered by the President and by Mr. Thomas, and he hopes that at no distant date Canal reservoirs will be established in the Dún and elsewhere, which would have the effect of preventing the destruction of fish when the canals are allowed to run dry for repairs. Captain Hearsey's report, of which the above is a short summary, is available for any member who may desire to see it.

Mr. H. S. Thomas, Madras Civil Service, has been pleased to accept the Honorary Membership of the Association.

(Sd.) A. SMYTHIES,
Honorary Secretary,
Dehra Dún Fishing Association.

DEHRA DUN,
24th March, 1888.

ADMISSION OF NATIVES INTO THE CLASS OF SUB-ASSISTANT CONSERVATORS.

WILL you, or any of your numerous readers, kindly inform me, through the columns of your valuable Journal, whether Natives who are not in the Forest Service can be admitted into the class of Sub-Assistant Conservators, provided they comply with all the conditions as laid down in para. 38 of the Forest Department Code now in force? A friend of mine, who received a regular training at the Central Forest School at Dehra Dún, and is an executive officer of long standing in the Department, and moreover fulfils all the conditions required from those of an outsider, recently brought this para. to the notice of his immediate officer, and asked him to send up his name for promotion to the class of Sub-Assistant Conservators, but to his great disappointment he was told that the said para. was intended only for the Europeans; which means, in other words, that Natives, whatever their qualifications may be, can never expect to become Sub-Assistants, but by a long and tedious process of beginning their career in this Department as Foresters and Forest apprentices.

I have ventured to submit these remarks to you in the hope of obtaining your fair and impartial opinion on this really very important subject, as well as of other just and generous Forest

officers who really feel and take an active and deep interest in the welfare of Natives.

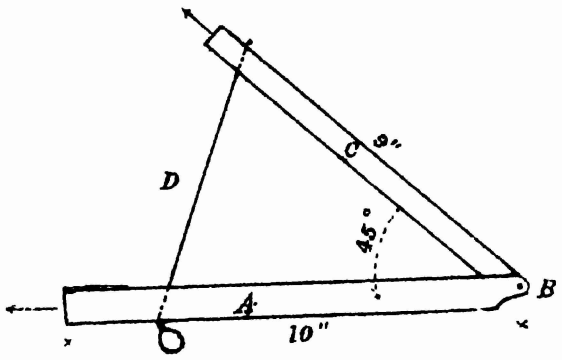
20th March, 1888. JUSTICE.

Note.—Our correspondent may assure himself that deserving men of all races in India are eligible for promotion to the grade of Sub-Assistant Conservator. A reference to the latest Classified Lists of Forest Officers gives the following :—

Bengal, ...	1	Native out of	7	appointments.		
Assam, ...	2	„	„	3	„	
N.-W. Provinces and Oudh, ..	3	„	„	4	„	
Punjab, ...	2	„	„	3	„	
Central Provinces, ...	5	„	„	5	„	
Berár, ...	3	„	„	3	„	
Burma, ...	2	„	„	6	„	
Madras, ...	3	„	„	10	„	
Bombay, ...	7	„	„	13	„	
Total, ..	28			54		[ED.]

HEIGHT MEASURER.

I SEE Weisse's height measure figured on page 169 of the "Forester" for April, and as I have used for some years a somewhat simpler form, I enclose description of it and sketch.



A is a small bamboo tube with the upper side cut away, and attached by two small pins to another smaller one C at the joint B, so that the tube C can fold down *into* tube A. D is a non-elastic string knotted outside, as per sketch, and when open these tubes are at an angle of 45°. To measure a tree, peg the ring of a measuring tape in the stem at 3 or 4 feet up, and holding the tape and measurer in left hand, or with both, step slowly back holding A level, and when, looking through *both tubes*, the upper one is in

line with place to be measured, the tape then measures the exact height to that point.

S. E. PEAL.

ON the 30th of April about 5 P.M. a thunderstorm passed along the Siwalik hills, and in its course a flash of lightning struck a young green sál tree of some 18 inches girth, on one of the numerous summits of the range about 2 miles to the north of the Beribara rest-house in the Saháranpur district.

This tree was at once in a blaze, and one of its branches falling on to the grass beneath, at this time of year as dry as tinder, set it on fire, which was at once carried by the wind into the surrounding jungle. In spite of the storm of rain the fire burnt over some 300 acres before it was finally extinguished.

There are about 12 feet of the trunk of the tree still standing, all charred and burnt, the fallen branch has been sent into the head-quarters of the Division at Dehra Dún.

L. M.

I AM credibly informed that a distinguished traveller observed in Southern Bengal a magnificent creeper or climber, I forget which, which he pronounces to be the mango in a form never observed by Anglo-Indians. Could this curious fact, if fact it be, have escaped our observation and only revealed itself to the trained powers of a scientific traveller, or could it have been a cucumber; which our eminent observer mistook for a mango?

The same authority tells the English farmer, that the increase in the export of wheat from India must soon cease, that in proportion as wheat culture in India extends, the pulse crops must be driven out of the fields, which are required for the more valuable grain crop, and that the natives, having no pulses to fall back upon, will soon be obliged to consume their own wheat. I believe we Anglo-Indians always were of opinion that few, if any, of the pulse crops occupied the fields at the time when wheat was grown.

I am startled, but perhaps some of your numerous readers are more confident as regards facts, and will kindly put me straight. I must, however, warn them before they are rash enough to contradict the traveller, that he is an eminent Professor on the eve of publishing for the information of the British public a book on the Agriculture and Forestry of India, and I only

A FORESTER.

JJ. Reviews.

THE JOURNAL OF THE AGRICULTURAL AND HORTICULTURAL SOCIETY OF INDIA, Vol. VIII., Part II., NEW SERIES.

This pamphlet contains, first, an interesting paper on *Erythroxylon Coca* grown in India, by C. J. H. Warden, M.D., F.R.C.S. This plant flourishes in Ceylon, but has hitherto been cultivated too much in the shade to produce strong plants or much seed.

A closely allied species *E. monogynum* is common in the hot dry districts of Ceylon, and the leaves have been largely used by the poor of Southern India, in times of famine, though it is not known whether they contain cocaine.

The Agri-Horticultural Society distributed seedlings of *E. Coca* in 1885-86 to Assam, the Duars, Darjeeling and Cachar, and Dr. Warden has analysed leaves sent from various places in these districts, and has explained in detail all his experiments to obtain marketable cocaine from them. The best results are from the Arcuttipur Tea Company's Gardens, Cachar—1·671 per cent. of alkaloid being obtained from anhydrous leaves of 19 month's seedlings grown in vacancies in a tea clearance, on sandy loam manured with old cowdung and root top dressings. Here, the altitude is 120 feet above sea level, and the rainfall (average of six years) 129 inches.

The alkaloid prepared by Dr. Warden has been used in the Medical College, Calcutta, in 13 cases of cataract, and is reported to be a perfect anæsthetic. The percentage of alkaloid contained in the Indian drug exceeds considerably the amount hitherto published as obtained elsewhere, and the fact that it does not spontaneously form crystallizable salts is not considered a disadvantage, as the salts are as a rule used in solution.

Dr. Warden does not, however, advocate extensive cultivation of coca in India, as the quantity produced in South America is enormous, and the price has declined since 1884-85 from 2*s.* 6*d.* to 2*d.* per grain in 1887. It is also probable that it may be prepared artificially by synthesis, on a large scale.

The next paper is **On the work of the U. S. Entomological Commission**, by E. C. Cotes, 1st Assistant to the Superintendent,

Indian Museum, Calcutta, who has just published a most valuable paper on the wheat and rice weevil. This Commission has issued their first Annual Report for 1887, and their enquiries into the natural history of destructive insects and the most promising methods of combating their ravages are particularly interesting, as showing how a large amount of loss may be avoided in India. It is stated that kerosine oil emulsified with soap or milk, to enable it to be diluted in water, and the flowers of *Pyrethrum cinerariæfolium*, or burach, ground to powder and diluted, are among the best insecticides, and so are Paris green and London purple, two compounds of arsenic, which are used largely diluted.

Mr. Cotes anticipates that whole districts in India may be saved from the most destructive pests by watchfulness and the judicious administration of poison at the right moment, on a few square yards.

He states that the expense of spraying infected plants, such as tea bushes infected with red-spider, need not be prohibitive, as 1 dollar 33 cents sufficed to sprinkle effectively half an acre of cotton plants affected with the cotton worm, in America.

Mr. Cotes gives a sketch of the prominent insect pests of North America, with the means adopted to check their ravages, among these are, the Rocky mountain locust, the canker worm, the Hessian fly, the cotton worm, bark lice attacking the orange tree, the white pine weevil, the Colorado beetle, &c., &c.

Paper No. III. consists of correspondence **relating to the improvement of Cattle and Horses and production of Wool in Bengal,** including a valuable report on Bengal wools by Mr. Orrah. The latter states that 30,000,000 sheep yield on an average 111,000,000 lbs. of wool containing 5,000,000 lbs. of sulphur, all of which must come from the soil. Mr. Orrah considers it reasonable to expect that the prolonged growth of wool on unmanured land should result in the extermination of grasses containing much sulphur, and therefore recommends dressing of such lands with gypsum.

It has, however, first to be shown that the sulphur is an essential element for good wool, and does not result from the excretion of a material not required by the sheep in its internal economy, as in the case of silica or soda, frequently found in plants, but which they can dispense with, without the slightest effect on their well-being.

Paper No. IV. is a study on the **Mango Weevil,** by W. J. Simmons, the Honorary Secretary of the Microscopical Society of Calcutta.

The minute structure of this pest is carefully described, and the writer considers it probable that the imago of *Cryptorhyncus mangiferæ*, the curculion beetle in question, protects itself from July to April, during the drenching monsoon and the cold season, in crevices in the bark, but this requires observation, and after its habits have been accurately ascertained, we shall be in a position to wage war on the insect with every prospect of success.

The Bengal mális believe that the weevils come from the air, but in Tayler's "Thirty-eight years in India," it is stated that an unusually sacred and malicious fakír being offended with Mymensingh, (where and in Assam, weeviled mangos are most common,) cursed the mangos of the district, and they have remained cursed ever since.

Paper No. V. is a note on **Lokao, the Chinese green dye** yielded by various species of *Rhamnus*, by D. Prain, M.A.

The Chinese species are *R. davuricus*, *tinctorius* and a doubtful species growing at 6,500 feet in South China.

Mr. Prain thinks it would be interesting to ascertain whether any of the indigenous species would yield similar dyes. These are in the N.-W. Himalayas *R. purpureus*, *triquestrus*, *virgatus*, *pusicus*, *procumbens*, and it would be interesting to experiment on their leaves, the process being—

"(1). *Chop up the leaves and boil them thoroughly.*

"(2). *Leave the residuum undisturbed for three days, and then put it into large earthen-ware vessels.*

"(3). *Take up colouring matter by immersion of cotton cloth prepared with lime.*

"(4). *After five or six immersions, the colour is washed from the cotton and again boiled.*

"(5). *Lastly it is taken up on cotton yarn, and sprinkled on thin paper, and thoroughly dried.*"

The last paper of this highly valuable Number of the Society's Proceedings is the 100th **Annual Report of the Royal Botanic Garden of Calcutta, for 1886-87**, by Surgeon Major G. King, M.B., LL.D., &c., giving a comprehensive history of the garden. This has been already noticed in our pages.

THE QUARTERLY JOURNAL OF VETERINARY SCIENCE IN INDIA.

No. 23, April 1888, Vol. VI.

THIS Number contains an editorial on Horse-Breeding operations in India, in which the encouragement of local breeds of horses, such

as those of Katiáwar, Kohlapur and Mysore, and the Hyderabad country breds, in which the Arab strain is well marked, is strongly urged on Government. It is represented that with war in the N.-E. Frontier, it would be difficult to ensure the escape of Australian consignments from Russian cruisers, while in a later and very interesting paper by the late Colonel Valentine Baker on the Turkoman horses, it is shown that Russia has an unfailing supply of hardy remounts to depend on. There is a vivid description of a Turkoman raid by Ferrier quoted by Colonel Baker, a part of which is worth quoting.

"Ferrier thus describes a raid. When the Chief thinks he has assembled a sufficient number of men to insure the success of the expedition, he names that day month as the day of departure, this time being required for each man to get his horse into that high state of condition without which he could not support the extraordinary fatigue and hardships he has to undergo. During this month the forage for a horse for twenty-four hours consists of 6 lbs. of hay, or clover-hay and about 3 lbs. of barley, or one-half the ordinary quantity of corn. This reduces the animal considerably in flesh, which is the object in view, the first step in his training. His pace improves under it, and he is thus prepared for the strengthening and somewhat singular food which he is subsequently to have. The horse is then put to his full speed for half-an-hour every day, and is not fed for some considerable time after he comes in. Very little water is given him, and if he is eager to drink, it is a sign that he ought to fast a little longer, but this training never exceeds a month. The thirty days having elapsed, the Turkomans take the field, each of them with two horses; the one the charger which has been trained in the manner described, the other a yaboo, or inferior animal used for burden which the Turkoman mounts on leaving his "aoul" (encampment) and which carries him to the Persian territory. This follows him without saddle or briddle and never strays from the party, for both have been accustomed to follow their master like dogs from the time they were foals. The first day's march seldom exceeds three parasangs (13½ miles), the second four, the third five, and the fourth six. When they arrive at this point the Turkomans change the forage of the charger, and substitute 4¼ lbs. of barley flour, 2 lbs. of maize flour, 2 lbs. of raw sheep's tail fat, chopped very fine, all well mixed and kneaded together. This is one day's rations without either straw or hay. The horses are very fond of this food, which is given them in balls and puts them in tip-top condition, and after having been fed in this manner for four days they are capable of supporting the longest forced marches. Then, and not till then, their masters mount them, and prepare for the work of pillage."

III. Official Paper.

INDIAN FIBRES SUITABLE FOR TEXTILE PURPOSES.

The following report of a Conference held in the Commercial Room of the Imperial Indian Court of the Colonial and Indian Exhibition, 16th June, 1886, on Indian fibres suitable for textile purposes is published for general information :—

Report of a Conference held in the Commercial Room of the Imperial Indian Court of the Colonial and Indian Exhibition, 16th June, 1886.

Present:

Sir E. C. Buck, LL.D.	Mr. T. Christie.
Dr. G. Watt, C.I.E.	Mr. E. Cross, of Messrs. Cross and Bevan.
Dr. Forbes Watson.	
Mr. F. B. Goodyear.	Mr. Collyer.
Mr. E. Joynson.	Mr. Routledge.

The following fibres suitable for textile purposes, amongst many others, were placed by Mr. T. N. Mukharji on the tables and were examined ; those marked with * being specially commented on :—

*Abroma augusta.	Hardwickia binata.
Abutilon asiaticum.	Hibiscus cannabinus.
Agave americana.	„ esculentus.
Anona reticulata.	„ macrophylla.
*Bauhinia Vahlii.	„ tiliaceus.
*Bœhmeria malabarica.	„ vitifolius.
*Bœhmeria nivea.	Kydia calycina.
Broussonetia papyrifera.	Laportea crenulata.
*Calotropis gigantea.	*Maoutia Puya.
Crotalaria juncea.	*Pavonia odorata.
Daphne papyracea.	*Sida rhombifolia.
Fourcroya gigantea.	Urena lobata.
Gerardinia heterophylla.	*Villebrunea appendiculata.

It was generally acknowledged that the collection was a valuable one, and that some of the fibres were likely to become commercially useful. It was strongly urged, however, by the commercial men present that before any real opinion could be given on the merits of any one fibre, it was necessary that the whole series should be examined by a scientific expert, and their qualities from

a chemical point of view thoroughly determined. Further, that information as to the quantity of each obtainable, the probable price, and the channels through which the fibres could be obtained in bulk should be furnished.

The general opinion seemed to be that research should be maintained, and some system established by which samples might be furnished to merchants in Europe, together with the information necessary for commercial purposes; that sample rooms should be established in London.

Sir E. C. Buck believed that the Government would be prepared to furnish any samples that might be required for the purpose of chemical examination, and procure most of the information likely to be called for. He could not undertake to say that funds would be forthcoming for scientific examination.

Mr. Cross (of Messrs. Cross and Bevan), with Mr. Joynson, then made a liberal offer to make scientific and practical experiments on the whole series of fibres in the Indian Courts, and promised to send an official letter the following day to that effect. Mr. Cross's exceptional capabilities as a chemical investigator are well known. All that these two gentlemen asked for was that the results of their investigations might be published by the Government of India, and that samples in reasonable bulk should be supplied, accompanied with any information which might be obtained as to the available quantity and probable price.

The fibres on the table were then examined in detail. Dr. Watt drew special attention to the fibre of *Sida rhombifolia*, and explained that the plant was one of the commonest roadside bushes in India, but in his opinion, if cultivated, was capable of great improvement. Instead of yielding a fibre only 3 or 4 feet long, such as the samples exhibited, it might be made to afford a fibre as much as 8 or 10 feet long. This fibre was much admired by the gentlemen present. Its white silvery colour was regarded as of importance in rendering it suitable for purposes to which jute could not be applied. In texture it is soft, and in point of strength and durability superior to jute, while the ultimate fibre is much finer, making it suitable for many purposes for which linen is employed.

Attention was next drawn to the fibre *Abroma augusta*. Dr. Roxburgh's description of the fibre, published 50 years ago, was read, in which its superiority over jute is discussed. The plant is a perennial, and yields three crops of fibre a year. It is not, however, cultivated at the present day, and Dr. Watt explained that this is in all probability due to the unprecedentedly rapid develop-

ment of the jute industry. The experts who examined this fibre, however, pronounced it as less valuable than *Sida rhombifolia*, on account of the hardness of the fibre and want of elasticity.

The various species of rhea were next taken up and commented upon favourably, but the opinion seemed to be that rhea might be regarded as in good hands and making all the progress that could be expected for the present. The samples shown, in the Glenrock Company's trophy, were viewed as fairly representative of the present position of the rhea industry.

Strong white fibres from the stems of *Calotropis gigantea* were carefully examined, but the difficulty in separating this fibre was viewed as almost prohibitive, especially when fibres like *Sida* and *Abroma* were available. The floss from the seed was incidentally looked at, although not intended for this Conference. Mr. Collyer expressed a strong opinion that the only obstacle in the development of this substance was the difficulty of procuring a constant supply.

The various samples of Hibiscus fibres were carefully looked at, *Hibiscus cannabinus* and *Hibiscus esculentus* were pronounced superior to *sunn* hemp (*Crotalaria juncea*). Mr. Collyer, however, stated that he had a shipment of *sunn* hemp on its way to England, and would gladly take more if procurable, but in this as in most other cases of minor fibres the difficulty was regularity of supply. It was explained that the two species of Hibiscus alluded to are, however, so familiar to the Indian cultivators, that a demand would certainly create a supply, and it was suggested that if Mr. Collyer would only furnish particulars of price, quantity required, &c., these would be communicated to the Provincial Departments of Agriculture, and doubtless a market might be created.

Special inquiry was next made into bast fibres suitable as substitutes for the Russian linden fibre which is used so extensively by gardeners. Dr. Watt placed before these gentlemen for this purpose *Kydia calycina*, and while this was approved as a strong clean fibre, it was objected to on account of cutting when tied hard. Others were then shown, such as *Hardwickia binata* and *Bauhinia Vahlii*. Regarding the last-mentioned fibre Mr. Routledge said he had seen this fibre bleached and spun in the usual manner with admirable result, and expressed a strong opinion in favour of this common climber coming into European commerce.

The various examples of American aloe fibre were next examined, but the verdict seemed to be that India could not hope to compete with America. Mr. Christie alluded to an article which recently appeared in the "Times" regarding an Indian new fibre

which had been taken up by a manufacturer in consequence of an interview which he had had with Dr. Watt. The fibre in question was produced and examined, and Mr. Christie expressed himself as satisfied that the report in question was fully justified, but was a little annoyed on being told that for one week the name of this fibre would not be divulged. It may here be explained that this was in consequence of the manufacturer alluded to having specially asked that his application of this fibre should not be made public. Sir E. C. Buck agreed with Dr. Watt, that this concession might be granted, since it was hardly fair that a manufacturer who displayed enterprise in spending his money in order to ascertain the value of a product should not be protected until such time as would enable him to finish his experiments. This was explained to Mr. Christie, and the gentlemen present agreed that it was quite right not to communicate one merchant's secrets to another. The fibre in question was the fibro-vascular bundles from the interior of the stem of *Caryota urens*, a palm not uncommon in India. It has been somewhat eagerly adopted by representatives of two branches of trade, one of the most important being its substitution for bristles in hair brushes, a use which if found generally practicable might lead to a very extensive demand; the other as a substitute for whalebone in the manufacture of corsets. This palm also yields the *kintul* fibre of Ceylon, but that fibre is derived from the leaf-sheath and not from the stem.

Second Conference, 25th June, 1885.

Present:

Sir E. C. Buck, LL.D.
Dr. G. Watt, C.I.E.
Dr. Forbes Watson.
Mr. J. H. Wilson.
Mr. E. L. Gibson.
Mr. T. Archer.
Mr. R. Brushfield.
Mr. G. Ricketts, C.B.
Mr. C. Beadle.
Mr. T. Wardle.
Mr. Routledge.
Mr. T. Christy.
Mr. C. Cross.
Colonel Howard.
Mr. Bryan Donkin.
Mr. G. Wells.
Mr. W. L. Scott.

Among others the following fibres were placed on the tables:—

Abroma augusta.
Abutilon asiaticum.
Abutilon indicum.
Agave americana.
Bauhinia Vahlii.
Bœhmeria nivea.
Calotropis gigantea.
Calotropis procera.

Edgeworthia Gardneri.
Fourcroya gigantea.
Gerardinia heterophylla.
Hibiscus cannabinus.
Hibiscus esculentus.
Laportea crenulata.
Marsdenia tenacissima.
Maoutia Puya.
Sida carpenifolia.
Sida cordifolia.
Sida rhombifolia.
Urena lobata.
Villebrunea appendiculata.

The object for convening this further Conference on the subject of textile fibres was to give an opportunity to a second set of gentlemen to examine the large collection now on view. The same opinions were expressed as to the duty which should devolve upon Government, as have already been recorded in the Conference of the 16th. It is, therefore, unnecessary to repeat these, as also the various opinions given on the fibres shown, but since the date of the last Conference the fibre *Bauhinia Vahlii* has been carefully and independently investigated by two gentlemen, Mr. Wilson and Mr. Cross, both of whom have now pronounced a very high opinion regarding it, and some time previous to either of these gentlemen Mr. Routledge gave a similar report. When bleached it is found to be of a bright silky and woolly character, highly adaptable for admixture with wool. The length of the fibre would seem to render it valuable and economical for many purposes for which cotton is at present employed. Numerous inquiries have been made respecting the area over which the plant which yields this fibre is to be found, and it seems very probable that at an early date a Company may be formed for the purpose of cultivating the plant. It was suggested that, perhaps, the best region for such an experiment would be in the plateau of Chota Nagpur, where all that would be necessary would be to plant the climber over a certain area and clear the jungle sufficiently to allow of spontaneous propagation as freely as possible. From experience in forest conservancy it is believed that no amount of pruning, for the purpose of manufacturing the fibre, would in any way interfere with the growth of the plant, since in its wild state it is a constant source of annoyance to the forester, who is said to find it most expensive to keep the creeper from injuring his young trees. A peculiar point in its favour is that while a climber, it does not twine round other plants, but attaches itself by means of tendrils, so that the shoots may be obtained many yards in length without being twisted. a fact which greatly facilitates the separation of the bark in long strips. In point of chemical features it stands amongst vegetable fibres almost by itself, since, unlike cotton, it may be bleached and dyed by the same processes as are applied to wool. It is therefore

eminently suitable for admixture with wool, but it loses in weight very considerably if treated with alkalies like cotton.

The silver white fibre of *Sida rhombifolia* attracted very great attention at this Conference as at the former one, and a very strong opinion was pronounced in favour of its substitution for many of the finer purposes to which jute has been applied in recent years. The chemical experiments which have now been performed with it fully justify the expectations held out at the former Conference, and several gentlemen have urged the desirability of an experimental cultivation. The samples shown were only 3 or 4 feet long, while jute may often be found as much as 15 feet. It was thought that if under cultivation *Sida* could be made to approximate nearer to jute in this respect a very great future would open out for it immediately. The fibre could be produced on the same field and by the same cultivators as jute, and for the same or nearly the same price.

A large number of the gentlemen present were interested in rhea, and a discussion took place as to whether the properties of the fibre, and the process of manipulation, could best be determined by the chemical and scientific experiments, or by practical tests. Mr. Cross and others maintained that there was no process in chemistry which, if desired, might not be reduced to practice, and no result in the laboratory which could not be obtained in the factory. In support of this he cited the immense improvement which had taken place in the sugar industry with the discovery of the chemical process of preparing beet sugar.

Mr. Minchin (of the Glenrock Company), on the other hand, maintained that it was hopeless to expect a final solution of the problem of rhea fibre from chemistry; what was wanted was a mechanical and practical process of dealing with it.

Dr. Watt then showed the *Puya* or wild rhea fibre of Assam, and also the Malabar species of rhea, and said that, in his opinion, it was far more important to ascertain the properties of the various species of rhea plants than to try to conquer the difficulties offered by that peculiar species known in the commerce as rhea or China grass. He pointed out that, in addition to rhea proper, there were perhaps 30 other species, all of which might popularly be called by the same name, but not one of which had found its way into Europe, or had been experimented with. He was of opinion that a species might be found which would not oppose the obstacles which had given so much trouble in the China grass industry. For example, the fibres of *Laportea crenulata* and *Villebrunea appendiculata* had not yet been carefully examined, while the former more particularly seemed a hopeful fibre.

Most of the gentlemen present took away samples of *Puya*, and have since brought them back bleached, cleaned, and carded in such a way that it is impossible to tell them from the true rhea. The question has been raised, could *Puya* be more easily and more cheaply cultivated than the true rhea, it being equally as serviceable. An interest has thus been awakened in the subject of the investigation of the properties of the various rhea fibres, and a number of experts have strongly desired to be furnished with a detailed report of the properties of all the fibres which may be called rhea, or are allied to the rhea.

A large assortment of cottons and silk cottons was carefully examined. Brown or *Nankeen* cotton seemed to be a curiosity, and considerable interest was taken in the samples of it shown. The long kidney Garo cotton was regarded as interesting, but the cottons of the Central Provinces and of Western India were viewed as in such a position commercially that it was not necessary to comment upon them. Indian cotton was a distinct and important article of trade, and required no assistance and no encouragement, as it was in the hands of large and influential merchants. The silk cottons, on the other hand, have still to be introduced to trade. Mr. Collyer explained that the difficulty he had experienced was in the matter of supply; he could not get a regular quantity.

For the purposes of upholstery, the *kapok* or the floss or hairs from the seeds of *Eriodendron anfractuosum* and from the floss of *Cochlospermum Gossypium* were viewed as hopeful, the latter particularly so, provided the supply could be uniform and large, and the article cheap. It was, however, the floss of *Calotropis gigantea* which seemed to be of most interest; and since the Conference a spinner from Lancashire (*see* file No. 100, Serial No. 2) has put himself into communication with a Missionary in India, at Dr. Watt's suggestion, in the hope of having the plant experimentally cultivated. The supply from the wild plant is too irregular to be depended upon, and hence it was thought that, if it could be cultivated on semi-waste lands at a moderate rate, by this process, a uniform supply could be maintained. Should this anticipation be realized, the fibre would be largely employed in place of cotton, and for new purposes. It is very light and difficult to be used, but it has been found possible to draw it mechanically into cotton yarns.

Mr. Collyer, at the close of the Conference, very kindly offered to examine all the fibres shown in the Exhibition, and to furnish the Government with his opinion of them as a broker, provided small samples were sent to his place of business in the City. Sir

E. C. Buck considered this offer one that should not be neglected, and accordingly gave instructions for samples to be furnished to Mr. Collyer, in order that the Government might be favoured with his report. It is only necessary to add that, when obtained, the promised report will be duly submitted in continuation of his brief abstract of the discussions which took place at the Exhibition on the subject of fibres suitable for textile purposes. Mr. Cross has also commenced a detailed examination of the fibres of India, both chemically and microscopically, and the highest expectations may be held out as to the good results of Mr. Cross's labours. He has microscopically photographed the ultimate fibrils of all the fibrous plants placed before him. If no other good results accrue from the Exhibition, it may confidently be stated that India will derive much benefit from the conferences and reports which have been or will shortly be published regarding her textile resources.

Since the above Conferences a very remarkable interest has been displayed by commercial men all over the country. Inquiries have been almost daily addressed to the office of the Imperial Court, and it seems admitted on all hands that, without necessarily increasing the amount of manufactures, there is room for two or three fibres being added to those presently in use. The fibre of *Sida rhombifolia* bids fair to be one of the first to come into the market. It is now being experimented with by flax, cotton, and jute spinners. Messrs. G. Walker & Co., of Newtownards, Ireland, have received a large sample of the fibre, and are testing it upon flax machinery. Through Professor D. W. Thomson, of Dundee, it has been brought before the jute manufacturers, and Mr. Kenric B. Murray has been good enough to prominently place it before the members of the London Chamber of Commerce who are specially interested in textile fibres.

Interest in the *Malu* fibre, the fibre obtained from *Bauhinia Vahlii*, by no means lags behind that of *Sida*, and samples of this fibre carded and spun in a most interesting way have been submitted for inspection.

Mr. Cross has given much attention to the subject of *Calotropis* fibre, having by chemical processes converted this fibre into a most perfect vegetable silk.

A collection of the fibres of India has also been furnished to Mr. Collyer, and his report as a broker is expected to prove invaluable, being a natural accompaniment to Mr. Cross's report on the chemical and microscopic features of these fibres.

IV. Notes, Queries and Extracts.

The Forestry School at Cooper's Hill.—The Forestry School at Cooper's Hill is intended in the first place for the education of a certain number annually of young officers for the Indian Forest Department. The arrangements are, nevertheless, of such a kind that private students are admitted to the forestry course, in as far as space is available, and on condition that they conform to the rules.

It is in many ways advantageous that the Forestry School is attached to the Royal Indian Engineering College at Cooper's Hill. Although the course for forest students is necessarily different from that designed for engineering students, there are several subjects to be studied in common, and consequently the present arrangements admit of the forest students obtaining their training in surveying, descriptive engineering, and mathematics, for instance, in the excellent courses provided by the well-known Professors in the Engineering College.

The Forestry School itself consists of a block of buildings attached to the Royal Indian Engineering College, on the brow of Cooper's Hill, near Staines, and looking north over Runnymede and the Valley of the Thames. It is within a convenient distance from London, the traveller arriving at Egham (the nearest station on the London and South-Western Railway) in from forty-five to sixty minutes from Waterloo. Windsor Great Park is within a mile of the beautiful and spacious grounds in which the College stands, and the fine trees of all kinds to be met with in the neighbourhood give to the situation much that is desirable for a centre for the teaching of forest botany, and several parts can be made use of to a certain extent for illustrating subjects in forestry proper.

The building of the Forest School itself consists of large and small class-rooms, a museum, and the well-designed and appointed botanical laboratory. In this block the students pursue their main studies—botany, forestry, and entomology. Their other studies—engineering, surveying, mathematics, geometrical and freehand drawing, physics, geology, and one or two other subjects to be referred to presently—are pursued under the direction of the

various Professors in the class-rooms and laboratories of the Royal Indian Engineering College, to which the Forestry School is attached.

The forest museum is a convenient, well-lighted room, rapidly filling with useful collections of specimens illustrating the chief departments of forestry. Among the most valuable and conspicuous objects in this splendid collection may be mentioned the series of European and Indian timbers, which are so disposed that the student has ready access to them, while the Professors are able to refer to them in lecturing, and thus to make the teaching, in the best sense of the word, practical. Then there is a remarkably complete and interesting collection of implements used in forestry, and there are models of timber-slides, apparatus for catching timber, and other forest works, also so disposed that every student can handle and examine them and learn their uses with facility. Another valuable feature in this museum is the series of economic products of Indian plants. This is of course not complete, but the greatest credit is due to all concerned for bringing together for such useful purposes so many instructive specimens of fibres, seeds, barks, fruits, food-materials, &c., from the chief representative Indian plants; and when it is remembered that the Forestry School is so young, in this country (it was started in September 1885), it is the more praiseworthy that the authorities have made such good use of their opportunities and time. The collections must no doubt receive numerous additions as time passes, for it is well known that a museum takes many years to bring within measurable distance of completeness, but the Cooper's Hill museum is already fairly filled, the nucleus of the collections having been derived from the late Indo-Colonial Exhibition, and from the Royal Gardens, Kew. It would require too much space to enumerate the remaining interesting features of these instructive series of forest objects: specimens of timber showing the changes due to abnormal growths, the healing of wounds, the various injuries produced by unsuitable environment or by the attacks of insects and other living organisms, and last, but by no means least, a unique collection showing the ravages of those fungi which injure timber-trees, collected by Prof. Robert Hartig, of Munich, and presented to the School, and a collection of the more injurious forest insects, presented by Herr Oberforstrath Judeich, of Tharand. There is also a small herbarium, of a particularly interesting character, containing an excellent series of Conifers and other trees.

The botanical laboratory has just been completed, and is, without doubt, one of the best designed small laboratories, for its pur-

pose, that we have seen. It consists of an oblong room running east and west, and lighted from the north and east by windows arranged conveniently for work with the microscope. There are also tables and apparatus for experimental demonstrations in vegetable physiology; provision will exist for cultivating seedlings and plants at constant temperatures, for measuring growth, and for exhibiting the influence of light, gravitation, &c., on the growth of plants; and arrangements for showing the quantities of water given off from transpiring leaves, for developing plants in water-cultures, &c. The students are supplied with microscopes, reagents, and accessories, and are taught to familiarize themselves thoroughly with all modern appliances bearing practically on their studies.

The above-mentioned block of buildings also includes one small and one larger lecture-room, which are provided with necessary teaching appliances. The series of botanical diagrams especially are remarkably good, and in fact many of them are unique, being the private property of the Professor of Botany, and drawn and coloured by himself. Another feature which must not be overlooked is the projected botanic garden. This will consist of a series of seed-beds, &c., illustrating the raising of forest trees, and of beds of plants chosen from the most important natural families, in order that the students may familiarize themselves on the spot with their chief characteristics. This botanic garden is now in process of being laid out, and it will be ready for the use of students in a short time.

The courses of studies followed by the forest students are admirably adapted to the wants of practical men whose lives will be largely spent in the creating, planting, preserving, and using of forest and other trees. Obviously, such a course must comprise several branches of teaching, the one thing common to all being that they bear upon the practical needs of the future forester. That the same training applies to a planter or estate-manager needs no remark, and portions of the course would be suited for others engaged in work in woodlands, and in the colonies, &c. The full course, as at present set forth in the syllabus of studies, is as follows:—

The student begins work in September, and attends lectures regularly during two academical years. In engineering, he is taught the principles of road-making, and the building of forest bridges and other structures; he is also instructed in the practice and theory of surveying under the care of the Professor of Surveying. In his first year he studies for two terms under the Instructor in

Geometrical Drawing, and in his second year receives lessons in the keeping of accounts. To these subjects may be added freehand drawing, and a modern language. In addition to these more technical subjects, the student attends certain short courses in mathematics and in applied mathematics, under the Professors of these sciences; he also studies physics—in lectures, as well as in the laboratory—entomology, and geology. A short course on organic chemistry is now being commenced.

The rest of his work consists in the special training as a forester, and it may safely be stated that there is no other centre in the Empire where so thorough and excellently designed a curriculum for a forester or planter can be obtained. The two subjects of forestry and botany are under the care of separate Professors. Dr. Schlich lectures on forestry, dividing his subject as follows :— In the first year he deals with the various soils, climates, and the regulating effects of forests on these; sylviculture, artificial and natural woods; the tending, thinning, pruning, &c.; the protection of forests against man and other animals, and especially insects, and against injurious plants, climatic influences, &c. During the second year the student is instructed in the utilization of forests; the technical qualities of woods; the felling, shaping, transportation, &c., of timber; the utilization of minor forest produce; the preservation of wood; saw-mills; charcoal, &c. He then passes to the study of working plans, and especially the arrangement of cuttings; surveying and mapping forests; measurement and determination of ages of trees and forests; and the methods of regulating the yield of forests. The final course of lectures is on forest law. In addition to the lectures, the students also make occasional excursions, under the direction of Dr. Schlich; the neighbourhood of Windsor Forest facilitating this important object, and enabling the Professor of Forestry to make his teaching thoroughly practical.

In botany, under the management of Prof. Marshall Ward, the students are instructed by means of lectures, and practical work in the laboratory and in the fields and woods of the neighbourhood. The course in botany is designed to train foresters, not technical botanists: its aim is throughout practical, and directed to teaching the students exact and thorough knowledge of the life-phenomena of the trees and plants which it will be their duty to rear, and take care of, and utilize in the future. Commencing with a short course of thoroughly practical instruction in the elementary biology of plants selected as illustrative types of the vegetable kingdom, the young student is taught the use of the

microscope and how to apply it practically in examining the tissues of plants. He is then instructed in the organography and anatomy of plants, learning (not only in lectures, but also in the laboratory and in the field) what the organs of plants *are*, and what they *do*; so that roots, stems, leaves, buds, bulbs, tubers, tendrils, thorns, &c., become to him not mere abstractions, but objects on which his attention will be continually fixed as active parts of plants. The study of cells and their contents, of epidermis and stomata, of vascular bundles and other tissues—of wood, bark, cambium, and so forth—is carried on thoroughly, not only that the forester may know the principles by which to classify and recognize timbers and forest products, and learn their uses, but also that he may understand what these various parts of the plants do in nature: how heart-wood is formed, how the timber grows and may be improved, how wounds may be healed over, how the roots take up substances from the soil, and how the plant makes use of them, and so forth. The student concludes his first year's study in botany (in the early summer) by familiarizing himself with the names and systematic position of the plants in the neighbouring fields and woods, especial attention being paid to the important trees and shrubs, and their relations to the forest flora of India.

During his second year, the student is instructed in the physiology of plants—how they feed, respire, and chemically change substances in their interior; how they grow, and are affected by light, gravitation, temperature, moisture, &c.; how they are reproduced, hybridized, and so on; the effects of various agents in the production of wood, in influencing the fertility, and so forth. The course is completed by the study of the diseases of plants, and especially of timbers, and how their effects may be minimized or healed.

As special features of the greatest importance, it should be mentioned that the senior students pay periodic visits to the magnificent gardens, museums, and plant-houses at Kew, under the direction of Prof. Marshall Ward, in order that their knowledge of the important economic plants and their products shall be real. They see the plants growing, learn to familiarize themselves with their peculiarities and habits and uses, and are thus not strangers to them when they land in India. Secondly, the young foresters are taken abroad, and taught what life in the forest really is. At the completion of their first year's studies, they accompany the Professor of Forestry to Scotland, or to the New Forest, or to the Forest of Dean, as may be decided for the year; and at the end of their second year they are taken to the Continent for three or four months' practical work in Germany and France, to examine the

systems pursued in the large and more systematically managed forests of those countries, and thus to study the art of forestry in practice under conditions more resembling those met with in the huge and valuable forests of India.

During the summer of 1887, for instance, the young officers who are now in India were taken to Bavaria, under the direction of Dr. Schlich, accompanied by Prof. Marshall Ward and Mr. Gamble. They visited the magnificent museum and laboratories of the Forestry School at Munich, the Forest of Freising, the willow nurseries and plantations at Oberberghausen, the spruce forests at Hohenaschau, and the timber depôt at Traunstein. They then proceeded to the Austrian forests of the Salzkammergut ; and later to the Forest School and school forests at Nancy, the cork oaks and pine forests in the Esterel, and the *Pinus maritima* forests on the west coast of France, used for the preparation of turpentine as well as for timber.

With this practical tour, the training of the young forester in Europe stops, and he departs for India to assume the new duties and large responsibilities of his life as a forest officer under the Imperial Government.—*Nature.*

THE FURTHER DEVELOPMENT OF THE TEAK TRADE.—Just as the exigencies of Good Friday had compelled us to complete our *Journal* for last week two days earlier than usual, a piece of news came to us by telegram from the East, which appeared to us of great interest to the British commercial world at large, and to the timber and shipping trades of this country in particular.

The intelligence we received was the report of a dinner which took place at Singapore on Tuesday, the 27th ultimo, at which General Sir Andrew Clarke, the guest of honour, informed his audience that the mission he had undertaken to Siam, in order to obtain a concession for the proposed railway from Bangkok nearly to the borders of Southern China, had been entirely successful, so that the line, which would go as far as Zimme, an important town near the northern frontier of Siam, will offer to the outside world of navigation the shortest available route to that part of the Chinese Empire which is now the least accessible to Europeans.

This portion of that vast empire is said to be occupied by an industrious and thrifty people, who will be glad to exchange commodities with us, and with whom there is every prospect of a large trade being opened. In *Hazell's Annual Cyclopœdia* for last year will be found a good account of the projected railways in our vast

Eastern possessions, from Southern Burma, including Moulmein, to Esmok, on the borders of China.

Messrs. Colquhoun and Hallett, the eminent engineers, who have surveyed the country and got railways already at work there, have also published the result of their surveys in a well-arranged and carefully compiled book with cuts and maps describing the entire country which the route traverses, to which we shall take an early opportunity of again referring.

These railways would run partly in British and partly through Siamese territory; the Government of the latter kingdom had, therefore, to be propitiated before this scheme could be carried out, and the necessary pre-arrangements appear now to have been brought to a successful issue.

It was one of the stipulations of the Siamese Government that a railway should be constructed from Moulmein to Raheng, in connection with the line from Bangkok to the northern border of Siam, and if that be agreed the British export trade to those regions will eventually go chiefly through Moulmein, which will then be the great emporium for goods and passengers from Europe to China and save the navigation of the Straits of Malacca and the long coast line of the Gulf of Siam at the back of them.

The countries through which these railways will run are thus described :—

"On the Chinese borders near the points touched by these railways are a range of provinces with an aggregate of 38,000,000 of people who have not a railway amongst them ; then there are the teeming millions of Burma and the rich country of Siam."

This is such a new opening for a great future trade that it will be like the intertrading of another India, and all these populations and principalities appear to favour British adventure. The King of Siam (an absolute monarch, with decidedly progressive tendencies), whose son was educated at Oxford, shows his appreciation of us by appointing British commanders to the sixteen steamships which constitute the Siamese navy.

The subject was well treated in the "Morning Post" of the 29th ultimo, from which, with reference to the teak trade, we make the following extract :—

"The central point would be Raheng, a city which, owing to many natural advantages, may be counted the most prosperous place, even under the present *régime*, in the whole kingdom. Its situation marks it out for future expansion, and it is destined to become an important distributing centre for both raw produce and manufactured goods. Its timber trade alone would suffice to en-

sure the success of a railway running up to the capital. Enormous quantities of 'teak' and 'sapan' are floated down the river, on which Raheng stands, every season. Unfortunately, the river can only be used for a short period every year, when there is sufficient volume of water in the bed to float the logs, so that it not unfrequently happens that the stores of wood lie by in creeks and shallows for weeks at a time, to the consequent loss of the dealers. Often whole rafts are destroyed by the fires which are only too common. All that is really wanted there is a means of transport such as could be depended upon at all seasons of the year to carry down the freights of wood, horns, skins, and beeswax gathered at Raheng from the country around, to the markets of Bangkok, whence it could rapidly be distributed by the shippers ever ready to receive it. Such a means of transport can only be furnished by the railway now to be constructed, which will take to Northern Siam the cotton, calico, and Birmingham goods so largely in demand there."

As the railway will run through territories abounding in teak forests, it is not improbable that the trade in that valuable timber will be at least quadrupled at Bangkok shortly after the completion of the undertaking.

Great trunk railways of 500 miles and upwards, however, are not constructed in a year; and if the wood is to be cheapened, which is all it requires to give it an important lead in every European market, it will be a very gradual process which need not disturb any existing engagements. But the trade will not have to wait the completion of the entire railway, as the opening of every fresh station while the work is proceeding will bring a great increase of trade to Bangkok; and as it is stated that teak and sapan would of themselves keep the railway going, we can judge of the great importance its timber trade is to the people of Siam. In the meantime, the connection between Upper and Lower Burma will still further add to the supplies of teak at Rangoon, and British shipping as well as its various export trades cannot fail to receive a new impulse from these steam roads to new and far-off lands hitherto scarcely brought within the boundaries of our commercial arrangements.

While our timber trade with America is decreasing, there is every prospect of that with our vast Eastern possessions, and their contiguous territories, largely developing, and it only wants the wood to cheapen for the consumption of teak henceforward to be greatly on the increase. Already it is becoming a favourite with ship-builders, coach-makers, cabinet and other trades, and will

easily supplant many other descriptions of timber directly the price comes nearer to those that are now used entirely on account of the difference in cost.

Before concluding our remarks, a few words on Bangkok itself may not be out of place, especially now that it is likely to play such an important part in the future history of the teak trade as well as in British commerce generally. It is the capital city as well as seaport of Siam, and has been, not inaptly, called the Venice of the East, because it consists of houses built in the sea on piles 10 feet high to avoid inundations, and, like the "city of song" just mentioned, every house has its gondola or boat. It is situated on an island formed by the River Menan, and lies 40 miles south of the Siamese boundary line. Its population is, according to Whittaker, 255,000, but another authority puts it at 400,000, which is probably the more correct. The country round about is very fruitful, and the interior is covered with vast forests, yielding teak, sapan, and other valuable woods; it is right through the centre of these that the projected railway will be constructed, not only further developing the trade with timber in the neighbourhood, but putting it in direct connection with Moulmein and Rangoon, and the timber from those districts lying between.

The harbour has a sand bank or reef, consequently only shallow vessels can come to the quays, and all the timber and other commodities to big ships have to be loaded outside the bar. However, in those regions this is not of much consequence, labour being always abundant and cheap, but if it were found any hindrance as the trade of the port further developed, capital would soon be forthcoming to overcome any obstacles in the way of rapid trade.

Bangkok stretches over a very extensive area and already is a large and busy town, and when put into direct and rapid communication with other thriving centres by the new railway, promises to become an important *entrepot* for British commerce.—*Timber Trades Journal.*

THE MOST EFFICIENT MEANS FOR PRESERVING WOOD.—A simple and cheap composition, easily applicable and thoroughly reliable as a preservative for wood, which during 11 years has stood the severest tests, and also for a considerable time found application in trans-atlantic parts of the world, has by reason of its eminent properties everywhere met with undivided attention, and may therefore now claim general recognition.

This important invention, commercially known under the name

of Carbolineum Avenarius, is an antiseptic (disinfecting) oil for impregnating and coating wood, and protects by its preserving and disinfecting properties all kinds of wood from decay, fungus and rot, keeping off, at the same time, its numerous enemies, such as insects and vermin of all sorts. It surpasses, in efficacy, all other remedies used hitherto, such as paint, tar, &c., &c., no less than the various nostrums recommended against the formation of fungus, being cheaper and by far more reliable than any other substances. Carbolineum Avenarius stands pre-eminent not only as the great preserver of wood, but also of stone (nitrous exudations) for damp walls, for the conservation of ship tackle, and other purposes as may be seen from the various testimonials. The application of this antiseptic oil is most simple, and may be performed by anyone, either by means of an iron-bound brush or by dipping the wood into the fluid, and the impregnation will be all the more effective if the oil has been made warm previously. One of the characteristics and essential advantages of Carbolineum Avenarius is its ready penetration into the wood, whilst all substances previously employed only covered the surface, closed up the pores, and consequently accelerated the decay of the wood whenever the same was not sufficiently dry. Carbolineum Avenarius is neither liable to inflammation, nor does it contain poisonous ingredients; applied either on dry or on green wood, it will give the appearance of stained wood with transparent veins of a nut-brown hue. It may be stored in the original barrels, or in any other suitable vessel for an indefinite time, if efficiently protected, without the least risk of deterioration. One pound of Carbolineum Avenarius will cover a surface of about 3 square yards at less expense than any other material and at only one-sixth of the cost of adequate coatings with oil paint which it far surpasses by the permanency of its action, whilst, even as compared with tar, it maintains its superiority, being less stiff and more capable of penetration than this latter, therefore more effective and economical at the same time.

The Directors of the Palatine Railways have given the following testimonials :—"Two boards cut from one and the same piece of pine and of which for the sake of experiment, one was painted with Carbolineum and the other left unpainted, were buried in the ground, and after a lapse of three years examined. The result was that the wood on which the Carbolineum had been applied showed no signs of decay, whilst the other was found to be in a rotting condition." The General-Administration of the Independent Congo State, Department of the Interior at Brussels, reports

under date of December 4th, 1886, signed. Strauch, as follows :— "Carbolineum Avenarius keeps white-ants and other insects from piercing the wood for the purpose of depositing their eggs, and thus prevents its destruction. We also find that wood well impregnated with this liquid is better able to withstand the influence of damp air. We therefore recommend the use of Carbolineum Avenarius for all Government buildings, especially for those parts of the houses which come in contact with the ground." The Basle Missionary Trading Company received from their factory at Mangalore the following report written in October 1886 :—"The trial we made with Carbolineum Avenarius has been a success inasmuch as a log of wood which we had brushed over, once only with this fluid, was found intact, after having remained buried in the ground from November 24th, 1885, to June 22nd, 1886, whilst of a similar log buried from the middle of February to June 22nd, and not treated with Carbolineum Avenarius, half its substance was found destroyed by the action of white-ants."

Wherever the Carbolineum Avenarius has been introduced, it gained universal approval within a very short time, and is now used on railways : waggons, cars, telegraph poles, sheds, fences, and other wooden structures ; ship-building yards and harbour structures : vessels ; boats, cordage and ships' tackle, locks, wooden bridges and all kinds of wainscoting ; building and mining trades : for all wooden parts above and below ground ; farmers' and gardeners' implements, such as vans, carts, ploughs, water-casks, trunks, posts, piles, poles, &c., &c. The Carbolineum Avenarius is now in almost universal use, and has everywhere met with the most flattering recognition by public bodies, and by the industrial and farming interest, as proved by numerous testimonials from Government and municipal authorities, railway directors and architects, many of such certificates being founded on ten years' trials which triumphantly exclude the last doubt in the mind of every impartial observer as to the sterling and unsurpassed properties of the Carbolineum Avenarius, which is now supplied from three factories in daily increasing quantities. All further enquiries to be addressed to Mr. Paul Lechler, Stuttgart (Germany).—*Indian Agriculturist.*

Mahogany Experiments in Southern India.—The experimental cultivation of this important timber tree continues to receive particular attention in the Madras Presidency. From a report by Mr. J. S. Gamble, Conservator of Forests, Northern Circle, on experiments carried out last year within his jurisdiction, we gather

that altogether 85½ lbs. of seeds were received by him from various sources, which were distributed in the districts of Ganjam, Kistna, Nellore, Cuddapah, and the Nilgiris, between the months of August 1885 and January 1887. In addition to the above, 1,200 plants in baskets were sent by the Director of Agriculture in October 1886, which were distributed between Cuddapah and Nellore. Full reports have been received from all districts except Ganjam.

In the Kistna district, of the plants raised from seed, some 1,500 were planted out at distances of 36′ × 36′ in the Weld plantation at Masulipatam, which covers an area of about 80 acres. The soil is described as sandy, containing a varying proportion of clay and slight traces of salt. The seedlings have thriven very well here, and now vary from 2 to 4 feet in height. In addition to the above, there are about 3,780 plants in pots in the nursery, which the Collector intends to plant out during the present rainy season. Other species of trees (among them *Terminalia Arjuna* and *Cedrela Toona*) have also been planted out with the mahogany, and the two named are doing very well. This plantation may be considered one of the successful ones.

In Nellore the results were not very satisfactory. Of 300 plants raised from seed, 112 died, and the remainder were planted out in the jungle. These have not grown well, though they are described as still healthy and strong. Of the 700 plants sent in October 1886, 468 were alive in January 1887. Out of a second batch of 10 lbs. of seed sent to the Collector in September 1886, only 562 plants were raised, of which 25 died. The reason why so few plants were raised from seed is, that it was sown in sand instead of in good soil, and also because the Collector thinks it was received too late in the season.

The most satisfactory results were obtained on the Nilgiris. No less than 13,300 plants were raised from two consignments of seeds in August and October 1885, and planted out in the June and November following, at an average distance of 22′ × 23′. There were only 63 casualties, the rest being in flourishing condition, especially those in the bed of the stream. The height of these seedlings varies from 18 inches to 4½ feet, while that of those on higher ground varies from 12 to 18 inches. In September 1886 a further consignment of 10 lbs. of seed was received by the Collector of Nilgiris, which was sown at once, and gave 5,000 plants, out of 11,145 seeds, the sixth day after sowing, the rest of the seeds not having sprouted even. This goes to show that more than 50 per cent. of the seed was bad. No casualties have occurred among

these, and they are reported as being from 5 to 6 inches in height, and healthy. The Collector notes that a moist locality appears to suit the plants better than dry places, and this hint might be utilized to advantage in further experiments. Mr. Gamble considers this plantation a decided success. It covers 100 acres, and a further note upon it is under preparation. We entirely concur with Mr. Gamble in the opinion expressed by him, that "the experimental cultivation of mahogany had better perhaps in the future be confind to Sriharikot and the lower forests of the Nilgiris. It is of no use to make small plantations in a case like this; the only way to really prove that mahogany can be properly grown, and to produce some result commensurate with the expenditure, is the work on a sufficiently large area."

In the Cuddapah district there are two plantations, and the district forest officer has submitted a somewhat full report upon them, which we have reproduced *in extenso* elsewhere, as it contains some interesting features.

Taken as a whole, it must be admitted that the experimental cultivation of mahogany in Southern India has been attended with hopeful results. There is no reason why this tree, the wood of which is so much valued by cabinet makers, should not become naturalized in this country. If the trees now being raised can be induced to produce fertile seed, it ought not to be such a difficult matter to naturalize it. There are, if we recollect rightly, some really fine specimen trees in the Royal Botanical Gardens, Seebpore. There is one tree in particular which struck us as one of the finest we have seen, it must be fully 80 feet high, with a girth of about 12 feet, approximately.—*Indian Agriculturist.*

THE GROWTH OF RAIN DROPS.—When several rain gauges are set up in the same locality, but at different heights, a curious fact usually presents itself. The quantity of rain that is falling on a given surface is shown to diminish with the height. This, according to ordinary notions of the supply of rain from the clouds, appears very paradoxical. Some meteorologists even question the accuracy of the rain gauge record. Thus Professor Cleveland Abbe attributes the difference to the action of the stronger winds to which the rain gauge is exposed when set high up. These, he suggests, carry the drops to one side, so that the higher gauge catches less than the lower one. I do not see how that accounts for the obsered facts, but they are easily explained if we reflect a little on the ordinary physical conditions of rainfall. I say the "ordinary" conditions, not the exceptional conditions. One of these ordinary conditions is that the air through which the drops of rain fall is

fully saturated or even supersaturated with aqueous vapour; and another is that the temperature above is lower than that below, and therefore the drops of rain coming from above are cooler than the air through which they are falling. This being the case, each drop acts as a condenser to the vapour through which it is passing, and thus grows in size as it descends. This increase of the size of the drops has been well observed, and is not at all covered by Professor Abbe's explanation. The following is an experience of my own. I started on a "soft day" to ascend Ben Nevis. Rain was falling at Fort William. At about half way up the mountain there was a mixture of rain and sleet. Gradually the proportion of snow flakes increased, and finally before reaching the summit, dry snow was falling. I have passed through the same series on other occasions. It would be the common experience of tourists, but for the fact that we rarely start to climb a mountain in wet weather. The characteristic "nimbus" or rain cloud is a cumulus or rounded cloud extending downwards in shapeless mass, cloud above, mist below. The whole cloud is supersaturated stratum of atmosphere in the condition of condensation and precipitation, the rounded upper surface indicating the upper boundary of this condition. Rain is produced throughout this cumulo-stratus cloud at all elevations from its woolly summit down to its base, which very commonly rests on the earth's surface. There are occasions when rain drops diminish as they fall. This must of necessity occur whenever the rain is formed above a dry stratum. In such case the falling drops must rapidly evaporate. The north side of the Romsdal (Norway) is a magnificent wall of dark-coloured rock, ranging at the lower part of the valley from 2,000 to 3,000 feet in height. Over this are poured a multitude of cascades, some of them mere threads of water. On a clear summer's day the continuous sunshine warms the dark rock so effectively that some of these minor falls, after breaking as they all do into snow-like spray, vanish altogether by evaporation. I witnessed this on both of my visits to this valley on hot days of different summers.—W. Mattieu Williams, *in the "Gentleman's Magazine."*

We read in "Nature" that the Government of Ceylon has sanctioned the opening of a Forest School at Kandy, and we wish it every success.

ORDER OF THE LIEUTENANT GOVERNOR OF BENGAL. FORWARDED BY

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THE FORESTS OF MANIPUR.

By GEORGE WATT, M.D., F.L.S., C.I.E.,

Reporter on Economic Products with Government of India.

Position and Physical Features of Manipur.—From the Bay of Bengal, near Chittagong, a closely-packed belt of mountain country rises from the plains of Bengal, Cachar and Assam on the one side, and from Burma on the other. This wall extends through the so-called Chittagong Hill tracts to Manipur and onwards north-east to the Naga Hills, until it terminates in the Patkoi Hills and the Bhutan Himalaya. Manipur is thus the middle portion of this highland country, and lies within Lat. 24° 13′ and 25° N. and Long. 93° 10′ and 94° 50′ E. It is traversed by a bewildering series of approximately parallel ranges which trend S. W., and are every now and then knotted together by transverse spurs in the vicinity of the culminating peaks. Within these ranges a number of valleys are hid, the largest and most southern being the valley of Manipur proper. This is inhabited by the race of people known as the Manipuris (or Meitheis as they call themselves), while the surrounding hill tracts are peopled by various races of Nagas, and recently by certain invading Kukies or Lushais. These Nagas and Kukies speak some twenty entirely different languages—a fact which may be accepted as indicating the ancient subdivision of the State into small isolated tracts of country inhabited by antagonistic races. The total area of the territory is about 8,000 square miles—the valley proper comprising only some 650 square miles. The entire population of the State has been returned at 139,000, of whom 65,000 are Manipuris. It has been estimated that out of the total area of the valley proper only about 200 square miles are cultivated, while 400 square miles of rich soil, of almost perfectly

level land, having a mean altitude of 2,570 feet above the sea, remain to be brought under cultivation, together with an amount of hilly culturable land of which no calculation has yet been made. The Nagas, like all other hill tribes, cultivate the slopes of the hills —terracing laboriously the land near their villages. They seem to have been driven to the crests of the hills through persecution, since evidences exist everywhere of a former more extensive cultivation on the lower slopes and valleys—parts of the State now almost entirely covered with rich grass and inhabited by wild animals. One cannot think of a more favourable region for tea cultivation. Miles upon miles of rich land, superior to anything found in Cachar or Assam, exist everywhere in this lovely country, while, in justification of this opinion, it may be added that forests of wild indigenous tea are to be seen throughout the eastern and north-eastern divisions of the State. Within the valley numerous low red clay hills exist that were once covered with pine (*Pinus khasiana*) and other trees, but these by a slovenly and destructive policy have all been removed and not replaced. The hills further up are thickly wooded, but the migratory Nagas and Kukies are annually effecting terrible havoc on the forests, the jhuming system of cultivation being everywhere permitted. Trees that have taken perhaps a hundred years to grow are ruthlessly hewn down and burned, in order to clear small plots of ground which are cultivated for one or at most two years and then deserted. Forest fires occur annually, and even the valleys are periodically burned, thereby utterly destroying all chances of natural reforestation.

But to convey an impression of Manipur sufficient to afford a key to its interesting flora, we must endeavour to give a more perfect idea of its mountain and river systems. About four days' march to the north of the capital, the frontier bordering on the Naga Hills is reached. All along this journey the parallel hills, to which I have alluded, are seen to ascend higher and higher towards the transverse ridge which forms the frontier and great water-shed between Manipur and the Naga Hills. The rivers on the western side of Manipur finally escape into Cachar, those that traverse the Naga Hills into Upper Assam.

The Khasia and Garo Hills of Assam springing up from the banks of the Brahmaputra stretch east, through the ranges known as the northern Cachar Hills into Manipur and the Naga Hills, abutting at the great transverse water-shed which is extended still further east into Burma, until it terminates in the lofty peak of Sarameti, 12,600 feet in altitude. The Assam arm of this transverse mountain system thus separates Upper Assam from Cachar, and com-

pletes the isolation of the waters of the Indo-Burman region. But this curious bifurcation of the mountains of Eastern India (south of the Himalayas), exercises also a great restricting influence over the vegetation at the same time that it largely controls the rainfall. To understand this, we have but to recollect that the rainfall on the southern face of the Khasia Hills at Cherrapunji is 474 inches annually, while a few miles off at Shillong it is only 84·8 inches. Throughout Manipur a similar erratic distribution occurs, being at one place but a third of what it is at another only 17 miles distant. Passing east along this wall—(a wall to the south, but practically parallel to the Himalayas, and transverse to the series of ranges which extend to Chittagong)—evidences exist everywhere of the influence of the great triangles formed by the mountains which throw the waters south through Manipur, south-west through Cachar, and north through the Naga Hills, into Assam. The moisture-laden clouds from the Bay of Bengal pick up more and more water as they pass over the rivers and marshes of Eastern Bengal, only to dash their torrents against this transverse wall which intercepts the clouds on their way to the Himalayas. But on advancing north the clouds are caught up in the numerous parallel valleys, and are thrown this way and that, and so broken up that the rainfall in one locality, often not more than half a mile from another, may be quite different. These local modifications of rainfall have their exact counterparts in the forests, the greatest possible contrast occurring on the two sides of a peak or spur. The average annual rainfall of the valley of Manipur proper is perhaps about 49 inches, but it is much greater on the hills.

The mountain ranges on the eastern side of Manipur and the Naga Hills are so compact, that the rivers have to struggle for a long time before they can find their way into Burma. A few streams do, however, artificially cut their way through these ranges ; and thus Manipur is ultimately drained west into the Barak—the river of Cachar—and east into the Ningthi or Upper Kyend-wen, one of the head streams of the Irrawadi. The great transverse range or watershed which divides Manipur from the Naga Hills is not, however, the only connecting link between the Manipur parallel mountain ranges. I have already remarked that these ranges are knotted together by spurs from the culminating peaks. These cause the rivers that have been flowing south or south-west to be deflected back to flow for the same distance north-east, only to meet other spurs round which they escape to resume their south-westerly direction. One may stand on a ridge and admire the glistening silvery streams on either side so near, that in fancy a stone might be dropped into

their eddying pools ; and yet these waters are one and the same flowing in opposite directions. This picture is repeated time after time, each day's march bringing the traveller to the shoulder of a hill where he stands amazed and puzzled as to his own position. No country could be more troublesome to the explorer, and it requires the most careful observation to preserve a record of the day's wanderings. The river basins, usually so convenient a mode of preserving such a record, are altogether misleading. In one day two or three rivers may be crossed, one flowing north and the other south. I may illustrate this fact by tracing the course of the upper stream of the Barak. This wanders up and down through the series of parallel ranges which form the western wall of Manipur before it finds its outlet into the plains of Cachar. In following its meanderings we shall obtain a conception of the western mountain ranges ; and as these are densely clad with forests of a kind altogether distinct from those found on the eastern side of Manipur, it would in any case become necessary to devote some time to the study of these hills. The writer, in a paper read before the Anthropological Society of Great Britain, has described the scenery and rivers of the western wall of Manipur thus :—"The road from Cachar to Manipur passes over nine nearly parallel ranges, and these constitute the western wall of the valley. This road is carried by giddy cane suspension bridges across the deep and blue rivers which flow between the hills. These bridges are in many respects unlike the platted bark bridges of the Himalaya, being stronger and more durable. A long cane (the scandent stem of the palm, *Calamus Rotang*) 300 or 400 feet long, is carefully selected and drawn across the river. This, stretched at each end over a natural rock, or a masonry or wooden pillar, constructed for the purpose, is fastened by beams driven into the ground beyond the pillar. A second or even a third cane is similarly stretched across, and the belt formed by these canes is thereafter platted into a pathway of about a foot in breadth. The pillars are then carried to a further height of 6 feet, and two other strong canes are stretched across from the top of these pillars and about 3 feet apart ; these are fastened by more distant beams into the ground. A small doorway is left in the upper portions of the pillars leading to the pathway. By means of a carefully selected set of canes cut so as to leave at one extremity a V-shaped stump of a branch, the upper suspension canes are bound to the pathway by the V-shaped end being hooked on to one of the upper canes and carried below the pathway and tied to the opposite upper cane. The next one is hooked on to the opposite cane, then carried under the pathway and tied to the

other suspension. In this way the suspension canes are securely bound throughout the entire length of the bridge to the pathway, and while with the weight of the passenger the bridge curves and sways to an alarming degree, it is impossible to fall off the tunnel-like structure through which the traveller has to pass. Some of these bridges providing for the great rise in the rivers during the rains, are carried as much as 50 feet above the ordinary level of the water, and while a giddy sensation is caused by the water being seen to flow beneath the feet—a sensation as if running violently up the stream sideways—still at all seasons of the year, the rivers of Manipur may be crossed in safety."

"To illustrate more forcibly the deep gorges which cut up the mountainous tracts of Manipur, it may be here added that on the road from Cachar to Manipur the following large rivers are crossed :—The Jiri, the Makru, the Barak, the Irang, the Lengba, and the Limatak, in a journey of only about 80 miles. So deep are the gorges in which these rivers flow to the south, that in most of them the sun sets on the rivers some hours before its golden tints have faded away from the forest-clad summits of the hills which cast their gloomy shadows on the deep and still waters. Nothing could more forcibly depict the configuration of Manipur than a history of its rivers and their contortions before they are permitted to escape to the plains below. The Barak, the largest and most important river of the country, for example, rises N. E. of the Makru and Irang rivers, and flowing S. W. then N. E. and turning W. N. W. it resumes again its S. W. course, thus sweeping round the head streams of the Irang and Makru. Again flowing S. E. it receives in its course in addition to the Makru several small streams ; next the Irang ; still pursuing a southerly course, it receives the Tepai, which flows north from the Lushai country to join it ; at this point it makes a sharp bend and flows nearly due north until it receives the waters of the Jiri ; after which it enters British territory and flows west through Cachar. This is a brief history of the river system within the western wall of Manipur, a wall in which the Barail constitutes the most lofty range. An illustration of this kind shows how closely the mountain tracts of Manipur are packed with parallel ranges of hills and deep gorges."

This western wall terminates on the great water-shed, having Japvo in the Naga Hills as its culminating peak, 10,000 feet in altitude. Within this wall of parallel ranges numerous higher peaks occur with connecting spurs, which gather the ranges together like a great cobweb, and throw the rivers backwards and

forwards. The view seen from Japvo or any other lofty summit presents a vast undulating country, from which numerous gracefully conical peaks seem to ascend. The eye is unable to discern from a distance that this undulating region is a closely-packed mass of ranges, which are severed by the streams into deep dark gorges sinking almost precipitously for 2,000 to 4,000 feet before the dark green and sullen waters are reached. A few days' marching across these ranges (and the roads such as they are, all stubbornly do cross the ranges) soon conveys a practical conception of the character of Manipur.

From the foregoing observations, it may have been inferred that I desire to speak of Manipur as consisting of three well-marked regions, *viz.*, *the western wall*, the *central undulating region of low hills and valleys*, and the *eastern wall*. I shall now deal with each of these divisions separately.

(1). THE WESTERN WALL.—Starting from Cachar on a journey to Manipur, the traveller proceeds by the Government road across a level plain nearly due east until the Barak river is reached. This has to be crossed by small native boats, although in the hot season the sandy expanse of half-a-mile may be even forded. Beyond the Barak, at the village of Luckipore (14 miles from Cachar, or as the town is more correctly called Silchar), the first distant view is got of the Manipur Hills; for during the march hitherto, the northern Cachar Hills to the left have occupied the attention of the traveller. These Manipur Hills are by the people of the plains known as the Kala Nagas, but by the Manipuris they are the Owhy-nanglong. They rise up like a dark wall, well deserving the name "Kala," and completely cut off the eastern view. Immediately on leaving Luckipore, the road enters the low undulating hills known as the Hurung, beyond which a tract of country has been cleared for tea planting. On the hotter exposed rocky situations the shrubby feature of the Rajmahal Hills occurs—*Woodfordia floribunda*, *Helicteres Isora*, *Justitia Adhatoda*, and such other well-known plants abounding. Few, if any, trees are met with, that appear indigenous, although moringa, jack and mango are cultivated; and near the villages, the bamboo planted for shade, grows magnificently in tall gratefully shading avenues. In the more sheltered nallas which have apparently been denuded of their trees by the planters, but otherwise left with their rich vegetation—a profusion of ferns and grasses—a new and surprising feature exists in the tree ferns and large-leaved curcumas with a species of maranta (called by the natives *murta*). The last Tea Plantation is that known as the Jiri Ghât, from its bordering on

the river of that name. The Jírí river constitutes the frontier of Manipur, and separates the State from British territory. During the dry weather it is fordable, but in the rains it swells until it assumes the form of a great seething rapid stream some 40 yards wide. On the further side ascending the hills to the north and south a vast expanse of forest land is seen to extend. This is known as the Jírí forest—the only forest in Manipur from which timber is obtained. The other forests are too far away to be of any real use, and even in the Jírí forest the difficulty of removing the timber is very great. On crossing the river the road plunges into the forest, a long straight path through a dark, damp, flat expanse, carrying the traveller to an open glade where the Jírí river is again met with after having made a great bend to the east. Every now and then the road approaches the immediate bank of the stream which flows silently along its deep bed almost hidden by tall overhanging grass. Of the whole journey to Manipur, the part through the Jírí forest is the most difficult. Numerous streams flowing in damp muddy channels have to be crossed, and while the country does not ascend so as to reach above the malarial influence, it undulates sufficiently to make travelling troublesome. In November when I passed through the forest, the river and its tributary streams were all swollen, and at the same time a torrent of rain was pouring, which rendered the march as miserable as possible. On my return journey in May, I had also the misfortune to find it raining as hard as on the former occasion. Collecting specimens became thus an impossibility; but a diary was kept, and notes preserved of the trees and shrubs seen during the march. To the south of the road, it is generally stated that the chief tree of this forest is *Ficus elastica*, from which a considerable trade is done in caoutchouc. This fact is so uniformly repeated by all writers on Manipur, and was so consistently affirmed by all the natives I consulted, that there seems no doubt on the subject. Still I did not observe a single India-rubber tree in the part of the forest which the road traverses. Of the trees and bushes recognised, the following may be specially mentioned:—*Dillenia indica*, and a little higher up (met with near the bamboo forest of the next day's march), *Dillenia pentagyna*, its monstrous leaves contrasting gracefully with the feathery clumps. *Thespesia Lampas*, an elegant shrub with large yellow cotton-like flowers, is common in these forests, and re-appears again after the whole of Manipur has been crossed (say 200 miles due east) in the forests within the basin of the Ninghti. Along with *T. Lampas*, and abounding on the

damp muddy rivulet courses, occurs the bush *Kydia calycina*, and in the drier parts of the forest its associate *Helicteres Isora*. Overhead *Pterospermum acerifolium* spreads out its large maple-like leaves, and though not in flower, looked wonderfully well as seen from the higher undulations breaking the monotony of the heavy dark green foliage of its associates. On the return journey its long erratic flowers spread their fœtid odour everywhere ; but on that journey, interest was mainly concentrated on the dense clumps of the sacred 'Asoka' tree—*Saraca indica*. I had previously been familiar with this tree only as a garden plant in Calcutta, but I was charmed with its large modestly retiring clusters of elegant orange-red flowers seen below its deep glossy foliage. On the march up to Manipur these clumps of sombre foliaged trees were puzzled over, as from their not being in flower, they were not recognised. Not far off on the higher slopes, *Derris robusta* reared its head, displaying in profusion its elongated racemes of white flowers. Close by, also on the return journey, I was delighted to come across a new *Bauhinia*, which I named in my diary *Bauhinia tenuiflora*. As this species has not yet been published, it may be as well to give here a brief description of it. It is a large scandent bush, almost taking the place of *Bauhinia Vahlii* of other forests of this character, the whole plant having a thin ferruginous pubescence, especially on the young leaves. Leaves 9-nerved and about $\frac{1}{5}$ cleft on the apex. Inflorescence elongated, a corymbose-raceme, which as the flowers fall off bears below prominent scars. Flower stalk fully an inch long, and calyx tube from $1\frac{1}{2}$ to 2 inches—these two structures giving the flower an elongated tubular appearance possessed by no other Indian species of this handsome genus. Indeed it resembles most the Chinese species *B. corymbosa*, a fact of some interest, since a Chinese, or perhaps more correctly, a Malayan influence becomes more and more visible on wandering eastward through the Manipur State.

Every half mile forward the forest changes its character as the country ascends. *Mussænda glabrata*, an extensive climber, flaunts its long, white, leaf-like sepals over every bush and tree. The eye is gladdened with the flowers of *Tabernæmontana coronaria* (a familiar feature of the gardens of Bengal), with the clusters of white scented flowers of *Ixora nigricans*—a form of the plant which, in the character of the calyx, was found to differ so much from the type of the species as to almost justify its receiving a variety name. *Mussænda frondosa* and *M. macrophylla*, while less ambitious than *M. glabrata*, were on the return journey seen to speckle their surfaces, glow-worm-like, with their showy white

floral leaves. Along with these bushes, the stunted tree of *Saurauja Roxburghii* made its appearance—the first representative met with of the great family of the tea plant. As seen in these forests, this plant was devoid of the ferruginous tomentum usually ascribed to its leaves. Soon however it became associated with its near ally *Actinidia*, and a form of that genus which I first took to be *A. callosa*, but on comparison in the herbarium found to be a well recognisable variety, if indeed it should not be regarded as worthy of a specific position. *Meliosa pinnata*, a smallish tree with long pinnate leaves gave a new feature to these rich evergreen forests, which was greatly enhanced by the appearance of two species of *Elæocarpus*, *viz.*, *E. amœnus* and *E. lanceæfolius*. Both these trees are exceedingly handsome—their delicately fringed, drooping corollas being quite unlike any of the other flowers seen, but the former has a scientific interest worthy of being here recorded. Hitherto *E. amœnus* has been supposed to be confined to the southern provinces and the western peninsula, and distributed to Ceylon, but not met with in the eastern side of India.

(*To be continued*).

IMPROVEMENT FELLINGS IN THE DEHRA DUN SAL FORESTS.

I.—Object of these fellings.

The growth of these forests is irregular, consisting of old hollow or diseased trees, badly grown, crooked, deformed saplings, many of them unsound, together with a certain proportion of straight, fairly well-grown stems, all of which, however, cannot be estimated as sound. The causes of this state of things are sufficiently obvious—ill-treatment in the past, removal of the best mature trees in the days of wholesale contractors, forest fires from time immemorial, grazing, climbers, &c. It is our duty as a Government Department to endeavour to improve these forests, and to hand down to posterity a large supply of well-grown sound timber. The object of these fellings is to do this. It is quite certain that this will also have the effect of largely increasing the revenue.

II.—Necessary operations.

The necessary operations required to effect our object are as follows:—

1. Fire protection and limitation of grazing.

2. Climber-cutting.
3. Marking trees for sale.
4. Selling and removal of the produce.
5. Cutting-back and girdling.
6. Disposal of the material resulting from No. 5.

We will now take each of these heads in turn :—

1. These forests were first protected against fire in 1878 : they have consequently had the advantage of ten years' protection, and the result is a vast increase in the number of young seedlings and saplings which are sound ; in other words, there is a sufficient amount of advance-growth to justify us in marking the fellings. The means by which fire protection is ensured are described in Mr. Fernandez's "Manual of Indian Sylviculture," (pages 433 *et seq.*) and need not be repeated here.

Cattle are admitted to grazing in limited numbers during a portion of the year from the 1st July to the commencement of the fire season.

2. The next operation is climber-cutting. The two chief climbers in this forest are maljhan (*Bauhinia Vahlii*) and gauj (*Millettia auriculata*). The damage done by climbers is described in the "Manual of Sylviculture," pages 18 and 80—82.

Climber-cutting must be done at a time sufficiently previous to the felling that the climbers may become quite rotten by the time we wish to fell the trees. Experience shows that one full year may be a sufficient lapse of time to effect this, but it is safer to leave an interval of two years between climber-cutting and tree-felling. Thus a coupe, over which climbers were cut in November—March 1885-86, would be ready for felling in November 1887.

By that time the climbers would be quite rotten. This is a simple operation, and we need not dwell upon it longer. The nearer the climbers are cut to the ground the better, as it is gives less support to the new growth, and the top of the stool should be damaged as far as practicable, without wasting too much time on it, by smashing it with the head of the axe. Any new re-growth of climbers that appears will be dealt with in the cutting-back operations. There is some chance of the bark of *Millettia* being utilized as paper-making stock, and a possible sale of this material should be borne in mind.

Climber-cutting has to be done methodically under proper supervision, and it may well be done in April and May, as then we have a gang of men ready to hand in case of forest fires.

3. The next operation is the most important of all—marking the trees to be felled. The marking is done with the divisional

hammer, and every tree marked becomes the property of the purchaser of the coupe. Our five or six years' experience in this matter has enabled us to lay down the following rules :—

Rule I.—No tree, whether sál, sain, or kukat, under 6 inches diameter is to be marked. First, as regards sál and sain, the diameter of 6 inches, or girth of a foot and a half, is considered to be the maximum size above which sál and sain cease to send out useful coppice-shoots. No doubt they will coppice above this size, especially sain, but we then get a great number of shoots surrounding a large stool: they are hence weaker. What we want are one or two shoots on a small stool, because in these forests, owing to the quantity of seedlings in the advance-growth, there is no interest in obtaining any growth which will not eventually resemble a seedling. Now the cutting-back cannot be done by the purchaser, and it must be our work to do this: hence we cannot sell smaller saplings than this, or we might lose the re-growth altogether. Finally, the small saplings that have to be removed are very numerous, and we do not want to swell the total number of trees offered to the buyer by a large amount of almost worthless individuals. Although at the sale the trees are classified according to the size, the purchaser may be tempted by the large number to offer more than the coupe is worth. At one time we gave these small saplings away gratis; but there is no reason why this should be done, and the better plan is not to mark them now, but to remove them in the subsequent cutting-back operations.

Secondly, as regards kukat, there is no reason why these trees should not be marked, as we want to get rid of them and do not require a coppice-growth; but the marking and girdling of so many small trees take a long time and detract the attention from the more important operation of choosing the larger trees to be marked. They are worth very little to the purchaser of timber, and the correct principle is not to sell him such small and valueless material. We can get rid of them by girdling or felling in the subsequent operations.

Exception.—At the same time, if we notice kukat saplings overtopping and suppressing sound and straight-grown sál and sain seedlings, then we should girdle them, and also mark them with the hammer. But it must be remembered that we shall return to the coupe three years hence, and, unless the operation is a pressing and urgent necessity, it had better be neglected.

Rule II.—Any kukat tree that is suppressing, either directly or by lateral action, a sál or sain, or is likely so to affect a sál or sain within the next few years, must be girdled and marked.

Exception.—Certain trees that yield elephant fodder, such as the various figs, may be spared within a reasonable distance of the various camping places (say two miles). Also it will be as well to spare all individuals of *Terminalia Chebula* on account of the fruit it yields.

Rule III.—Other kukat trees, besides those immediately suppressing or injuring sál or sain, may be marked and girdled if they have a low dense cover like dhamin (*Grewia* sp.), or, if there are several in one group, we may mark some of them in the hope that seedlings of better species will produce themselves underneath.

Rule IV.—(Sál and Sain).—No growing tree in the prime of life is to be marked if it is straight, well-shaped, and completely sound and will not deteriorate during the next fifteen years.

The more we store up such trees—unhappily not very common—the richer fund are we laying up for the future.

Rule V.—(Sál and Sain).—Every tree which cannot improve during the next fifteen years, or which is now hollow, unsound, decaying, crooked, forked, &c., should be marked, subject to the proviso of

Rule VI.—No tree is to be marked the removal of which would cause a blank in the forest or increase an already existing blank; or in those localities exposed to frost, unless the advance-growth is sufficiently high not to suffer from frost (10 feet at least).

Rule VII.—Trees growing on the sides of a ravine, or at the head of a ravine, or on the edge of a cliff, should on no account be marked for fear of erosion.

Rule VIII.—We shall very likely find several sál and sain trees growing so close together that they interfere with one another's growth; in this case, although they may not fall under any of the above heads, we must remove some of them in order to admit of the better growth of the remaining trees. This can be only done by inspection and consideration on the spot. We must, of course, remove the worst ones.

The method of recording the trees marked and the manner of marking and measuring them can only be learnt in the forest itself.

4. The trees are marked during the working season, generally from December to March, and are sold by auction in August to the highest bidder. They are now sold altogether—sál, sain, and kukat in one solid lump. The purchaser is allowed twenty months in which to fell and remove the produce, and his operations last till the end of May in the second year after the auction.

5. It is then too late in the season to do any cutting-back, so this operation is not commenced till December or January of the next cold weather.

The felling and export operations have broken or bent a large number of seedlings and saplings of sál and sain, and we have, besides, all the saplings under 6 inches diameter which were left in the marking. We now deal with these two categories at once :—

Rule I.—All unpromising seedlings and saplings of sál and sain should be carefully cut back in accordance with the instructions given in the "Manual of Sylviculture," under Coppice, pages 401—405.

Exception.—If we find such growth under tall sound trees of the same species, then we leave it untouched, as their re-growth would not prosper under this taller crop.

Rule II.—The kukat saplings and young trees under 6 inches diameter may either be girdled or cut down about 2 feet from the ground (so as not to coppice). If it is found necessary to remove larger kukat, they should be girdled.

But as we must not create blanks in the forest, this rule will only apply to cases where young seedlings or saplings of sál or sain are found underneath, and not even then in frosty localities, unless the better growth is above the reach of frost.

Exception.—Wherever we find straight young saplings of kukat timber species (Jaman, Anogeissus, Haldu, Dhamin, Lagerstroemia,) which are not actually suppressing sál and sain saplings, we may leave them untouched, or we may even cut back unsound specimens of these trees under one foot girth, in places where they are isolated and the re-growth will not interfere with sál or sain ; but this should be carried out in moderation.

Rule III.—All climbers are to be cut ; wherever small enough they are to be pulled up by the roots. In some cases a re-growth will have sprung up from the old stumps of climbers originally cut, and numerous pre-existing seedling climbers will have developed. This is the opportunity for getting rid of all such.

6. The material which results from the last-mentioned operation should be dragged to the nearest export line and placed in stacks, assorted. The small poles of sál and even kukat are generally saleable. The smaller branches must be left on the coupe, and, when dry, their export will be undertaken by fuel purchasers ; but no carts should on any account be admitted.

The following statement shows the various operations simultaneously going on in five adjacent coupes :—

Series of Coupes.

E.	D.	B. / C.	A.

A.—Climbers cut in January 1885.
Trees marked in January 1886.
Trees felled from November 1886 to March 1888.
Subsequent operations in January 1889.

Thus in January 1889 we have the following operations going on :—

Cutting-back and girdling in A.
Tree felling in B and C.
Tree marking in D.
Climber-cutting in E.

DEHRA DUN : A. SMYTHIES.
April 1888.

DOES THE CUTTING DOWN OF A FOREST ON A HILL DECREASE THE QUANTITY OF WATER GIVEN OUT BY THE SPRINGS AT THE FOOT OF IT?

THE above question would generally be answered in the affirmative, though in a late number of the "Forester" it was stated that a Madras official held the opinion that it made no difference whatever to the springs. My object in calling attention to this subject is to point out to the Professors of the Forest School at Dehra that they have at their very doors the means of helping to settle this question. The water used for drinking purposes in Dehra is carried from springs at a place called Nalapani, some 2¾ miles north-east of Dehra. The springs are in fact at the bottom of the hill, on which stood the fort of Kalunga, the taking of which from the Gurkhas under Bulbhudr, in the latter end of 1814, cost the British Army the lives of General Sir R. R. Gillespie, 8 officers and 60 men, besides of wounded 22 officers and 849 men, many of whom died afterwards from the wounds received.

When visiting the site of this fort it is very difficult now to realise the state of things that took place there in 1814, all is so peaceful and quiet all around ; but feelings of indignation will

arise at the bad management that cost so much life and suffering; but it is not the bad management of former times alone that arouses indignation, very bad management is as evident now, but instead of men being destroyed, it is trees that have been destroyed, for the whole of the hill above the springs, has been ruthlessly swept clean of the sál trees that used to cover it, there is no reproduction, and the top and the upper slopes are being ploughed up, and the only source of sweet water for a progressing town like Dehra is being partly ruined for a little paltry gain.

In 1880 a scheme was worked out by the then Executive Engineer of the Dún Canals to bring the water from these springs into the town by pipes, and covered channels. He gave the supply as being in April and May 11,812 gallons daily, and in December and January 19,138 gallons, so that taking the population of Dehra at 10,000, this supply gave only 1·18 gallons per head in the hot season, and 2 in the cold season. This water would about do for drinking and cooking purposes; but for the drinking water for cattle, washing and other household purposes, the Raspanna water, which flows through the town in open channels, must be used: this water, it can be easily understood, gets very foul before it gets far through the town; the drinking of it without first boiling causes goitre, in the rains it is half mud, and it is so hard during the dry weather that it is not a pleasant water to wash oneself with, even with the aid of Pear's soap!!

The Executive Engineer proposed to build retaining walls at the springs, and so collect all the water into a masonry tank, and he hoped that this would increase the supply by some 25 per cent. At this time nothing further was done for want of funds, and the scheme was allowed to remain dormant till 1884, when the present District Engineer remodelled the alignment of the pipes, and cheapened the cost. In sending up the estimates he remarked as follows:—"There is an undoubted diminution in the actual discharge of the Nalapani springs, but this is certainly due to the whole of the trees in the neighbourhood of the spring having been cut down (*i.e.*, excepting a few trees close to the source), but as young trees are already springing up, it is expected that in a few years the supply will be as full as ever." He gives the minimum discharge as that on the 11th of June, 1884, when there was 8,640 gallons per day, and the maximum on the 2nd August, 1884, 51,050 gallons. The difference in discharge during May and June is not much, so the loss in the minimum supply was 3,172 gallons per day, or nearly 27 per cent., all owing to the cutting down of the trees. Last year the impounding walls and tanks for the head-

works were completed; and the supply taken on the 18th of June this year was 10,281 gallons per day, being an increase of 19 per cent. over the measurement made on the 11th June, 1884. This increase is clearly due to the construction of the impounding walls to a depth of 8 feet below the surface level; and is only a little less than what the Executive Engineer expected it to be. It certainly is not due to the growth of trees that the District Engineer looked to, to increase the supply, for though the trees were cut down 5 or 6 years ago, there is no reproduction whatever, the stumps of the sál trees are dead, part of the ground has been ploughed up; on part the usual scrub bushes that grow anywhere are dotted about here and there, while just above the springs there is a very large patch without an atom of vegetation of any kind on it; this is said to have been the site of a *cholera camp* of the Gurkhas last year.

The whole of the 10,281 gallons per day is not to go into Dehra, a small spring, giving on the 18th June 835 gallons per day, is left for the 12 villages near the springs, so that 9,446 gallons per day will be taken to Dehra for the 10,000 inhabitants; this is far too little, especially as it is believed that there are more inhabitants in Dehra now than there were when the estimate of 10,000 was made in 1880, and the number is rapidly increasing. The Municipal Board should at once take up, under the Land Acquisition Act, the land of this hill, and make it over to the Forest School, to be replanted with sál, and preserved and studied. As the pipes now being laid discharge the water into a reservoir a short distance from the Forest School, there would be no difficulty in keeping a record of the supply, and the Forest Department would by and bye be able to prove that the forests, lands and springs in the North-Western Provinces act in a natural way; and not "contrariwise" as they are made all to do in the benighted Presidency.

A. C.

NOTES ON THE SMALL BAMBOOS OF THE GENUS *ARUNDINARIA*.

Of the genus *Arundinaria*, which includes, according to the "Genera Plantarum," also *Thamnocalamus*, there are ten fully described Indian species, besides four which have only so far been named from leaf specimens. Of these fourteen species, one is South Indian only, one Burmese, and three occur in the North-West Himalaya, all of them extending eastwards into Sikkim. Eight species, including these three, are found in the North-East

Himalaya, one of them occurring in the Khasia hills also, making, with four endemic species, five for that locality. They are all small reed-like bamboos, but one or two of them, such as *A. racemosa* and *A. Hookeriana* have occasionally culms of over an inch in diameter.

The following analysis, based upon that given by General Munro in his "Monograph of the Bambuseæ," will serve to identify the nine fully described kinds, which occur in the Western Peninsula.

Branches of the inflorescence without bracts.
  Leaves and flowers on the same culm.
    Style 3-fid. Transverse veinlets very conspicuous— 1. *A. racemosa.*
    Style 2-fid. Transverse veinlets conspicuous.
      Nodes not prickly, internodes nearly glabrous, scabrid— 2. *A. Wightiana.*
      Nodes prickly, internodes woolly at top— 3. *A. Griffithiana.*
  Leaves and flowers on separate culms.
    Leaves narrow, few or no transverse veinlets.
    Leaves hairy along midrib, empty glumes nearly as long as the spicula— 4. *A. falcata.*
    Leaves glabrous beneath, empty glumes scarcely one-half the length of the spicula— 5. *A. khasiana.*
  Leaves broader; transverse veinlets somewhat prominent.
    Spicules 2–3-flowered. Nodes without a raised ring, internodes 5–6 inches— 6. *A. intermedia.*
    Spicules 1½-flowered. Nodes with a raised ring, internodes 7-8 in.— 7. *A. Hookeriana.*
Branches of the inflorescence with bracts.
  Transverse veinlets faint or none, bracts short— 8. *A. Falconeri.*
  Transverse veinlets prominent, bracts long— 9. *A. spathiflora.*

Besides these nine, a tenth, *A. elegans*, Kurz, occurs in the Nattoung hills in Burma from 5 to 7,000 feet, and the four species of which the leaves only are, so far, known, are—

11.—From Bhutan, a species with very small leaves, discovered by Griffith, and stated by him to be especially plentiful on the Dhonglaila Pass between 6,000 and 10,000 feet— *A. microphylla.*

12.—From the Khasia hills at 4,000 to 4,500 feet, collected by Griffith and Hooker, and especially near Moosmai waterfall. It

has very narrow thin leaves, 2 to 3 inches long by only ¼-inch broad, and the transverse veinlets very faint and distant—

A. suberecta.

13.—From the Khasia hills: Vern.—'Uskong,' collected at Moflong by Hooker— *A. callosa.*

14.—From the Khasia hills, collected by Hooker and Griffith at 5,700 feet, and by Clarke at Shillong, 5,500 feet. It has fairly large reticulate leaves with long ciliæ at the top of the sheaths and spiny stems with broadly auricled short sheaths— *A. hirsuta.*

Mr. C. B. Clarke has also a Khasia hills' species from Shillong wood, which is, I think, *A. callosa.* It has spiny stems like *A. Griffithiana*, and bracteate flowers, so that it will come into the section *Thamnocalamus*, between numbers 8 and 9. The transverse veinlets are very conspicuous, and the sheaths (*Fig.* 7) have a broad apex and ciliate ligule.

It is unnecessary to say much regarding the two chief species of the North-West Himalaya, *A. falcata* and *A. spathiflora*, for they have been fully described by Brandis in the Transactions of the Royal Society of New South Wales of 7th October, 1885 and the "Indian Forester" for May 1886, in which he has fully cleared up the difficulty which existed in their identification and separation. But the Darjeeling and North-East Himalayan species generally are less known, and a few notes regarding them may usefully be recorded.

The common small bamboo of Darjeeling, known as "Maling," and whose leaves are so generally used for feeding ponies about that station, is, according to my identification, and as I have stated in the "Manual of Indian Timbers," *A. racemosa*, Munro. It has only once been collected in flower, *viz.*, by Griffith's collectors on Birch Hill at Darjeeling in 1837. Since then 50 years have elapsed, and it is curious that in that long period the flowering should not have been again recorded. Griffith's specimens were very poor ones, so that good examples are much required. Darjeeling Forest officers should keep a look-out for it therefore, and remember that keepers of Herbaria, almost all over the world, will be glad of specimens. The Maling bamboo has a stem of some thickness, usually about 1 inch in diameter, but often somewhat more. The internodes are rough and rather long, reaching to 15 to 18 inches. The straw coloured, brown, hairy, rough sheath of the young stems is ciliate on the edges and blunt at the top with a long fimbriate ligule, is about half as long again as the internode, and bears a subulate apex which is usually recurved (see *Fig.* 1). The leaves are sometimes rather large, up to

about 6 inches long and ¾-inch broad, and they have very conspicuous transverse veinlets which are raised beneath. This bamboo grows gregariously on the hill sides, and the growth is almost impenetrable; it may be seen in perfection on the slopes of Mount Tonglo on the Nepal frontier range. The stems are very largely used for mat and basket work, for building native huts, and for fencing, and the leaves are an excellent fodder. Its range is restricted to Eastern Nepal and Sikkim from 6,000 to 10,000 feet elevation, and it already begins to get scarce east of the Teesta river.

The common small bamboo of the higher parts of the Nilgiri hills above 5,000 feet is *A. Wightiana*, Nees. It is also a gregarious species, and gives a very dense cover, such as may be well seen on the higher parts of Doddabetta and on the Kundahs, as for instance on the upper slopes of the valley of the Avalanché stream. It flowers annually, the flowers appearing on leafy stems in dense purplish panicles with capillary somewhat twisted pedicels. The stems are about ½-inch thick, the internodes about 12 inches long, and very rough, the nodes swollen and with a conspicuous ring formed by the base of the fallen sheath, below them. The sheaths are often very rough, and are blunt at the top with a row of stiff ciliæ. The leaves are 3 to 7 inches long and ¼ to 1 inch broad, the transverse veinlets very conspicuous. Beddome says that it dies down annually after flowering, but this point requires further investigation. Locally, it is spoken of as a "reed," and is sold as such by the Forest officers, but it is not much used. It is a handsome species, well worthy of cultivation.

A. Griffithiana, Munro, is a species of the Khasia hills, remarkable for a ring of thorns round the joints of the culm and thick tawny wool below the joints. It flowered in 1833 when it was collected, so says Munro, by the Assam deputation for the examination of the tea plant, under Drs. Wallich and Griffith. Hooker also got it at Moflong, but in leaf only. The leaves have transverse veinlets.

A. falcata, Nees, is found in the North-West Himalaya at from 5,000 to 7,500 feet. It is also, according to my identification, the "Titi nigala" of the lower Darjeeling hills, where it may be seen to perfection in the forests which lie in the square formed by the Reyang, Teesta and Sivoke rivers and the Latpanchor ridge, and also on the dry faces of the precipitous slopes overlooking the plains at about 2,000 feet elevation. It flowers annually, the flowers being small and somewhat resembling those of the rice plant though usually of a reddish colour. The stems are thin but

strong and with only a small cavity ; the internodes are usually 10 inches long and the joints are swollen. The sheaths are about 12 inches long, gradually narrowed into a point with a subulate apex, they are very thin and paper-like, and hairy at the top. The leaves are small, up to 4 inches long by ½ inch broad, are hairy and have no transverse veinlets. This bamboo is used for basket work, but less so than some other species. The Lepchas also use it for arrows, and for any purposes for which strong material is required.

Closely allied to the last species is *A. khasiana*, Munro, which is, however, recognisable by having glabrous leaves and different flowers. It is rare in Sikkim. I have specimens from Rungbee which I identify as this species, but it is possible that they may have been gathered from planted clumps in the Cinchona Plantations. The stems are like those of *A. falcata*, and thick and strong, but the internodes are only 7 to 8 inches in length. The sheaths (see *Fig.* 3) are papery, straw coloured, narrowed upwards but bluntly truncate, and with a long thin apical leaf. The leaves are larger than those of *A. falcata* and have no transverse veinlets. This species was collected in flower in 1850 by Hooker in the Khasia hills ; by Masters in Assam in 1839 ; in Sikkim by Hooker (at Purmia-chu) in 1848 ; by Anderson and Kurz in 1868 ; by Dr. Treutler in 1874 ; and by myself in 1879. It probably flowers yearly like *A. falcata*.

On the hills of the Dumsong Sub-Division about Dumsong, Rissoom, Khampung and Labah is a gregarious species which I found in flower in 1882, and which I identify as *A. intermedia*, Munro. In the locality mentioned, this species appears to take the place above 7,000 feet of the "Maling," and is known by the Nepalese name of "Deva nigala." The culms are usually yellowish, about ½–¾ inch in diameter, and have internodes of only 5 to 6 inches in length ; but they are strong and the cavity is small. The sheaths taper gradually to a blunt ciliate ligule with a short broad apical leaf (*Fig.* 4 enlarged from a small one). The leaves are small, up to about 4 inches in length and ½ to 1 inch broad and have transverse veinlets. Specimens of this bamboo were collected by Hooker in 1848 or 1849, so that 33 to 34 years elapsed between the two recorded flowerings.

The most handsome of the Sikkim Arundinarias is probably *A. Hookeriana*, Munro, a fine tall species known to the Nepalese as "Singhani" and to the Lepchas as "Prong." It is found here and there on the western side of the Teesta, but is most common to the east and on the hills overlooking the Teesta and Rushett

rivers at an elevation of 4 to 7,000 feet. It is easily recognised by its glaucous green culms, which have a blueish colour below the nodes under a raised whitish ring. The culms have large cavities and are soft; they are ¾ to 1 inch in diameter, and the internodes are 7 to 8 inches long. The old sheaths are easily recognised, for they have parallel sides for about half their length, and then taper gradually upwards to a fine end surmounted by a short blunt ligula and a subulate recurved apical leaf (*Fig.* 5). The leaves are rather larger and broader than those of other Darjeeling species, and they have conspicuous transverse veinlets. This bamboo has only been collected in flower by Hooker in 1848 or 1849 in Sikkim and East Nepal, and consequently if it has not already done so, it ought soon to flower again. It should be carefully watched for, and the leaves belonging to the same clump should be collected with the flowering branches, for those hitherto collected have been from separate plants. The seeds of this species are said to be edible, and the culms are used for basket work. It is a species which should be planted in gardens: I remember planting some, with other interesting kinds, in the Birch Hill Park and in other places at Darjeeling, but am unaware if they have thriven or not.

A. Falconeri, Bth., is a rare species, hitherto only known from Kumaun (Strachey and Winterbottom, 1848), and Nepal (Wallich, 1821), but C. B. Clarke has kindly given me specimens, which I identify as this species, and which were found in 1876 at Laghep in Sikkim at 9,000 feet, in flower. It is easily recognised from *A. spathiflora* by the much smaller bracts and by the spiculæ having only one complete and one rudimentary flower. The leaves are narrow and small, up to 4 inches long and ½ inch broad, and the transverse veinlets are not conspicuous.

A. spathiflora, Bth., is a well-known North-West Himalayan species, found between 8,000 and 10,000 feet, and, as Sir D. Brandis points out, is the true "Ringal" of commerce. It also occurs in abundance in the Darjeeling hills on the Singalila range, above 8,000 feet, where its yellow culms and red branchlets easily distinguish it. The culms are narrow, less than ½ inch in thickness, and the internodes usually about 6 inches long; but they are strong, and are used by the hill people for pipes, arrows, &c. The leaves have conspicuous transverse veinlets, and are short and rounded at the base. The old sheaths are rectangular below and rounded at the top, and have a long subulate apical leaf (*Fig.* 6). In the North-West Himalaya, this species flowered in 1848, 1863, and 1881, so that the period of its life is from 15 to 18 years. In Sikkim it apparently flowered in 1868. This also was introduced

by me and planted at Darjeeling, but I am unaware if it has succeeded or not.

The figures of the sheaths of seven species will show that they give characters by which they may be recognised. I regret I have been unable to figure the sheaths of *A. Wightiana*, *Griffithiana*, *Falconeri*, *elegans*, *microphylla*, *suberecta* and *hirsuta*. Of the last named, however, there are specimens in the Kew herbarium which show characters quite different from those of the other species. They are short, with stiff hairs and a broad blunt top surmounted by a broad, foliaceous, ciliated apex. The drawings of the sheaths of *A. callosa* and *intermedia* were made by enlarging those found on leaf-bearing shoots, and might perhaps require some modification. The rest are to scale from actual specimens, mostly in my own herbarium, or from drawings made by me in the forest.

The sheaths of *A. racemosa* are very rough and covered with shining brown spicular hairs, which are very unpleasant to handle, as they produce somewhat the same effects as those on the pods of the "cowhage" (*Mucuna pruriens*); the ligule is long and deeply fimbriate, and the apex or apical leaf narrow. The sheaths of *A. Wightiana* have similar irritating hairs to those of *A. racemosa*. The sheaths of *A. spathiflora* are also very well marked, as they are rounded at the top with a short fimbriate ligule and narrow apex. Those of the four species *falcata*, *khasiana*, *intermedia* and *Hookeriana*, are more nearly resembling each other, but may thus be separated—

Apex very short—	*A. falcata.*
„ medium-sized, broader in the middle—	*A. intermedia.*
„ long, narrow.	
Sheaths long—up to 16 inches—	*A. Hookeriana.*
„ shorter „ 10 „ —	*A. khasiana.*

The sheaths of the small bamboos of other genera, such as *Phyllostachys*, *Cephalostachyum* and *Pseudostachyum*, differ again so much that there is not much danger of mistaking them. I hope soon to be able to figure them in the pages of this Journal. As a means of distinguishing the chief species, without flowers, I have attempted an analysis which will, I think, serve the purpose—

A—Burmese species only—	1. *A. elegans.*
A′—South Indian „ „ —	2. *A. Wightiana.*
A″—North Indian (Himalaya and Khasia hills).	
B—No, or very faint transverse veinlets.	
C—Transverse veinlets none.	
D—Leaves hairy along the midrib, apex of sheaths very small—	3. *A. falcata.*

D′—Leaves glabrous, apex of sheaths long— 4. *A. khasiana.*
C′—Transverse veinlets faint, distant, scanty.
D—Leaf sheaths ciliate— 5. *A. suberecta.*
D′—Leaf sheaths not ciliate— 6. *A. Falconeri.*
B′—Transverse veinlets distinct, leaves at least 3 inches long.
C—Nodes thorny, internodes with tawny wool at the top— 7. *A. Griffithiana.*
C′—Nodes not thorny.
D—Shoot sheaths with very large auricled apices— 8. *A. hirsuta.*
D′—Shoot sheaths with narrow, subulate apices.
E—Sheaths rounded at top— 9. *A. spathiflora.*
E′—Sheaths pointed, truncate at top.
F—Internodes and sheaths rough— 10. *A. racemosa.*
F′—Internodes and sheaths smooth.
G—Apex broadest in the middle.
H—Ligule fimbriate— 11. *A. callosa.*
H′—Ligule blunt— 12. *A. intermedia.*
G′—Apex broadest at base— 13. *A. Hookeriana.*
B″—Transverse veinlets distinct, leaves shorter than 3 inches— 14. *A. microphylla.*

It is probable that a study of more numerous specimens, especially of the Khasia species, may detect errors in the above and lead to modifications, but as it is, it may prove useful. After all, as in the same locality, it is rare to find more than two or three at once, the determination can be simplified. In the North-West Himalaya, as Brandis has shown, there are two common species, *viz.*, *A. falcata* and *spathiflora*, and these are at once separated thus—

Flowers annual. Leaves without transverse veinlets, sheaths long pointed— *A. falcata.*
Flowers not annual. Leaves with transverse veinlets, sheaths rounded at top— *A. spathiflora;*

while *A. Falconeri*, while having only very faint transverse veinlets, has not the annual flowers of *A. falcata.*

In the Darjeeling hills the high level species are *A. spathiflora*, *racemosa*, *intermedia* and *Hookeriana*, and these may be thus distinguished—

Stems smooth, yellow, branchlets red, sheaths rounded at top— *A. spathiflora.*
Stems rough green, sheaths strigosely hairy, ciliate— *A. racemosa.*

Stems smooth, yellowish, thick-walled, leaves narrow— *A. intermedia.*

Stems smooth, bright green, thin-walled, with a blue ring below node, leaves broader— *A. Hookeriana.*

In the same region the low-level species *A. falcata* and *A. khasiana* differ from the high level ones in the want of transverse veinlets and from each other thus—

Leaves hairy along midrib below, apex of sheath very small— *A. falcata.*

Leaves glabrous along midrib below, apex of sheath longer— *A. khasiana.*

The species of the Khasia hills are thus distinguished—

No transverse veinlets, ligule blunt— *A. khasiana.*

Faint transverse veinlets, ligule ciliate— *A. suberecta.*

Transverse veinlets distinct, leaves very small— *A. microphylla.*

Transverse veinlets distinct, sheaths long, smooth, ciliæ few, short— *A. callosa.*

Transverse veinlets distinct, sheaths short, strigose, ciliæ many, long— *A. hirsuta.*

These graceful little bamboos form a very interesting group, some of the members of which are in cultivation and flower in gardens in England. The chief cultivated kinds are *A. falcata* and *A. Falconeri*, though the species most commonly met with and found to be perfectly hardy in the open air is the Japanese, *A. japonica.*

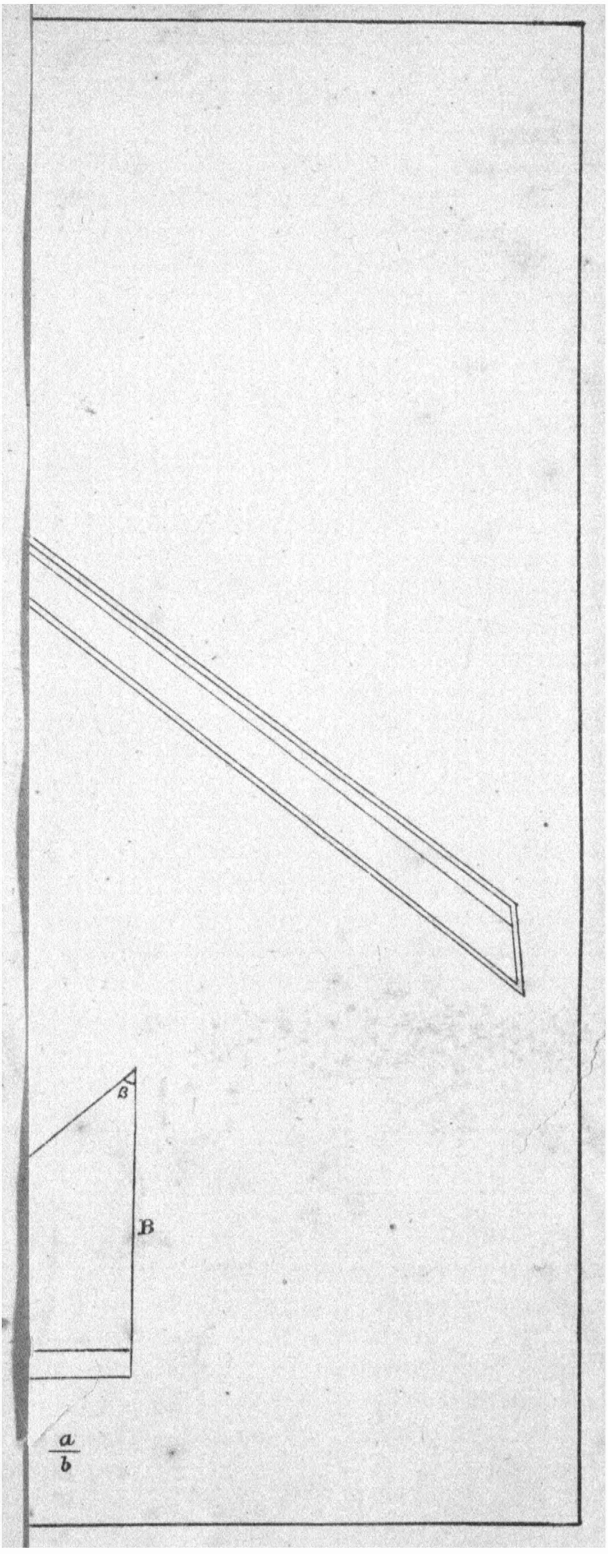
More information regarding the life-periods of these plants is badly wanted, also is it important to know if, when the flowering season occurs in the case of the more widely spread kinds like *A. spathiflora*, it is universal or not throughout its range.

KEW, J. S. GAMBLE.

February 29th, 1888.

DENDROMETERS.

THE April number of the "Indian Forester" contains a description of one of the many height-measurers which have been, and are still being, devised in Germany and France. The writer of that article gives no information as to the degree of accuracy attained by Weisse's dendrometer, but from his diagram—having never been fortunate enough to see the instrument,—I should think it must give a rather rough approximation, for the number of gradations shown (in the picture at any rate) is very small, and the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teeth which stop the pendulum—though very ingenious—must rather deter from the attainment of a great degree of accuracy.

It seems to me that a dendrometer, to be worth anything, should be qualified to give an accurate result. For every one with a little practice can judge the height of a tree approximately, and it is only when an exact measurement is required that a height-measurer is useful. Otherwise it were as well to dispense with instruments altogether, and simply to measure at sight or else by means of some of the simple processes which the natives themselves employ.

I have before me however a dendrometer which is at once very accurate, portable, and simple in construction. It is called Faustmann's Spiegel-Hypsometer.

This consists of a small board $7\frac{1}{2}'' \times 3'' \times \frac{1}{4}''$, to which are attached two little brass hinges, one at each end, which unfold, and give,—the one an eye-hole, the other, a cross-wire: between these, a slip of wood runs in a groove as shown in the figure, the groove bearing on either side a graduated table, 10 to 130, and the thread carrying the plummet (which when not in use, fits into a little cavity in the board,) is attached to the base of this sliding piece of wood, which, in order to take a measurement, is placed with its index opposite to the number corresponding to the base line measured.

Along the bottom of the board runs a scale of heights, about 26 graduations to the inch; while at the side is hinged a mirror in a metal case of nearly the same length as the board.

It is this very ingenious contrivance of Faustmann's which gives this instrument its character.

The mirror serves the purpose of the teeth in Weisse's hypsometer. For without moving the eye from the eye-piece, one can at the same time read in the glass, which is held with the left hand, the number where the pendulum intersects the scale of heights, and so a very accurate result is obtained. The numbers on the scale of heights are written backwards, so that when read in the mirror, they read straight.

The principle of the instrument is based on the same geometrical truth as Weisse's, and most other dendrometers But the writer of the article describing Weisse's instrument is wrong in supposing that he would have to change his scale to read feet instead of meters. The height read is relative, not absolute. Whatever unit is used for measuring the base line, the same will be the unit for the height given. My dendrometer too is marked for meters, but is equally true for feet or fathoms.

In conclusion, I may remark that this instrument may be very usefully employed as a clinometer,—in plane-table surveys, for example.

H. JACKSON.

COMPOUNDING FOREST OFFENCES.

THE correspondence that has appeared in the "Forester" on the above subject is interesting from more points of view than one, and shows the truth of the old adage, *quot homines, tot sententiæ.* In every province there appear to be different methods of reading the law, and of applying it, but the procedure of "Gorarh" is the most extraordinary of all. What is the size of his Division? Is the Ranger empowered by the Local Government to hold an enquiry into forest offences? if not, "Gorarh's" plan appears to me to be illegal; it is most certainly entirely opposed to the spirit of Section 67; to understand this, read Mr. Baden-Powell's letter in the "Forester," Vol. VII., page 156, and his remarks on "Jungli Sahib's" note, same volume, page 298. It is clearly expressed here that only such cases as come under the Forest Officer's own cognizance, should be treated under Section 67, that is a case which he has personally investigated, generally going to the spot, seeing the damage done and estimating it, and examining the accused and the witnesses, such procedure in fact as is mentioned in the Editor's note, page 166. But "Gorarh" sitting in his office or camp many miles off, on the mere report of a Forest Ranger, has "settled thousands of cases," by what I maintain to be an illegal method; it is no doubt an effective method, saves trouble, and looks well in the record; but it is not Section 67 of the Forest Act.

I must say that with "Jungli Sahib" (VII., 156) I thought Section 71 (*b*) empowered us to issue summons to compel the attendance of witnesses in any case, and have always acted on this assumption; but it appears from Mr. Baden-Powell's note that I was wrong, as this power only refers to survey of lands, boundaries, &c. This point should be authoritatively settled one way or the other—we should certainly be empowered to summon witnesses for the prosecution, for they may not always attend as readily as they appear to do in the School Circle, N.-W. Provinces. The whole question of the administration and working of Section 67 is one that is worthy of the attention of the Inspector General of Forests; it would be interesting and instructive to compare the

different interpretations of the Section in the various provinces, and some more uniform method of action would be desirable. As to the utility of the Section, there do not appear to me to be two opinions possible, and if the honest "Ghati" had a smaller Division to look after, he would probably alter his verdict.

SINGLE S.

FORESTRY AT THE CAPE.

MR. D. E. Hutchins, Conservator of Forests, King Williams Town, Cape Colony, writes as follows :—

I have to thank you for the consignment of box seed that, after some delay, at last came safely to hand. It looked all right, and I hope will germinate. As we have now a parcel post, would you kindly remember in sending me any seeds in future to send by parcel post. The boxwood seed was detained some time in London. I am sending you by this mail 5 lbs. of yellowwood (*Podocarpus latifolia*) and 5 lbs. of sneezewood seed (*Pteroxylon utile*). From the way that Himalayan trees grow on our mountain, I feel certain that both these trees will grow on the Himalayas. The yellowwood tree you would only grow for ornament or as a curiosity, but it is well worth your while to try and establish a culture of the sneezewood tree. The seed I send is from the large tree growing in the mountains. In these mountains all Himalayan trees seem to flourish, while on the low country between the mountains and the sea it is evidently too dry and hot for them. On the Perie mountains at 3,600 feet elevation, I have a collection of deodars and *Pinus longifolia* that have a curious history. The seed was originally sent some years ago by Sir Dietrich Brandis to the Grahams town Botanical Gardens. There the plants languished in a climate too hot for them, till they were liberally presented to me by the Curator, for planting on the mountains. A few months after being planted out, on the mountains, they took a new lease of life. Seemingly the growth now is all that could be desired. And it is pleasant for me to watch the development of trees, that I heard about in India, and yet left without even seeing.

Have you received our annual report, which I sent you, for last year 1886?

Can you put me in the way of obtaining a regular yearly supply of deodar seed? Perhaps you could tell me what would be the quotation per lb. in lots of about 20 lbs.

4*th March*, 1888.

AUTHENTIC CASE OF FOREST FIRE CAUSED BY LIGHTNING.

THE following instance of a forest fire which came under my special notice may help to convince those who are still sceptical as to this cause of forest conflagrations.

At the Kandar block of the Lambatách forest of this Division on the 17th of May last, a flash of lightning was observed to strike a deodar tree, and shortly afterwards the grass round the tree was observed to be on fire by some villagers who were at work in a neighbouring field, and who promptly proceeded to extinguish the flames, and then reported the matter to the Forest guard, whose choki is situated some distance off.

On the 2nd of June I examined the tree, and found that there can be no doubt as to the firing of the grass through the agency of lightning. It should be noted that the tree was half dry, the base having been injured by fire on some former occasion, and was therefore in a very inflammable condition. In another part of the block a green deodar tree was also struck, and half of the tree knocked away, but in this case the grass did not catch fire. This is the second time that a fire has happened at this block, though a flash of lightning on the former occasion during 1884, a kail (*Pinus excelsa*) tree having been struck and the grass lighted, but the evidence was not quite so clear as on the present occasion.

E. McA. M.

RATHI PUVU (ROCK FLOWER).

THE Rathi Puvu found in Bellary is probably identical with that found on the large rocks on Horsleykonda and Tottu hill in the Cuddapah District. Its use is unknown in the District, but some merchants from Anantapur export a few bandy loads annually. They pay a seigniorage of Rs. 2 per maund of 25 lbs., and sell in Anantapur at Rs. 10 or 12 per maund. In Anantapur it is eaten with curry, and is also used medicinally. The lichen is collected during the hot weather, *i.e.*, in April and May.

The business is very profitable, and the seigniorage rate might easily be doubled without causing any hardship to the merchants. Collection by departmental agency is being tried at present, and it is possible that this may induce the Anantapur merchants to make higher bids for the right of collection. The cost of collection and export is shown below.

	Rs	A.	P.
Seigniorage on 40 maunds, ...	80	0	0
Collection of do., at 8 annas per maund, ...	20	0	0
Cartage to Anantapur, 80 miles, ...	8	0	0
Total, ...	108	0	0
Sale of 40 maunds, at Rs. 10, ...	400	0	0
Profit, ...	292	0	0

CUDDAPAH, F. A. L.
7th June, 1888.

APPROPRIATION OF LAND UNDER SECTION 28 OF FOREST ACT.

A QUESTION has arisen whether lands in a Taluka in which the Revenue Survey has not been introduced can be placed under Section 28 of the Forest Act.

Proposals were submitted for notifying the lands as Protected Forest; but they were vetoed by a higher authority. According to Section 28, clause 3 of the Forest Act, (1878,) it would appear that no action can be taken until the lands have been surveyed, and the rights of Government enquired into and recorded. But surely there must be lands in other parts of India on a similar footing. And if there are, will some of your readers state what is done in those cases, especially if the forests are in danger of being rapidly destroyed.

One remedy of course would be to induce Government to introduce survey operations at once; but is there no other remedy?

23rd May, 1888. G. E. M.

In Section 28 of the Forest Act, it is clearly laid down that if the Local Government considers that enquiry and record are necessary, in the case of any forest, or waste land, but that such enquiry will occupy such length of time as that the rights of Government will in the meantime be endangered, it may, (pending such enquiry and record) declare such land to be a *protected forest*, but so as not to abridge or affect any existing rights of individuals and communities.—[ED.]

CATTLE STRAYING INTO PLANTATIONS.

I THINK the following correspondence between myself and my Collector might be useful to Forest officers as giving the law of cases in which the only adequate compensation would be obtainable from

the masters. Thus if 100 cattle in the charge of a little boy go into a plantation, the least one could chargo would be perhaps twice the daily rate, or 8 pies per head—total Rs. 4-2-8. Clearly in such a case the masters will have to pay, but as "Collector" says this is not obtainable from them criminally, but only as a *charge* for the material eaten.

A. G. HOBART-HAMPDEN.

I am continually being annoyed by largo numbers of cattle straying into a plantation, and the herdsman in charge (when he is present) is always too poor to pay—my plan being to charge twice grazing dues, or some such thing. Are the masters liable?

FOREST OFFICER.

The masters are liable in a Civil Court—that is to say, if you can *charge* a double fee, they could be made to pay.

But if it is a *penalty*, and imposed by you at a Criminal Court, the masters, being absent and not proved to have instigated the act, would not be liable for the doings of their servants.

COLLECTOR.

SIR D. Brandis writes as follows :—

The seeds of *Quercus incana* have germinated, and have yielded healthy plants both here and at Heidelberg. Professor Pfitzer desires his thanks to be expressed to those who collected, packed and sent them. *Q. incana* will not live out of doors in Germany, but the two other oaks might, and I would now suggest, that as soon as they are ripe, small bags of ripe acorns with charcoal be sent by pattern post. Very likely, if they are despatched sharp, charcoal may not be necessary, and to test this I would suggest say two little bags of each kind with charcoal, and two such bags without charcoal being sent when *Q. semecarpifolia* and *dilatata* ripen.

Perhaps it might be worth while putting this notice into the "Indian Forester." It gave us the greatest pleasure when these acorns germinated, and they are now healthy plants with green sharply dentate leaves, upper side somewhat shining and grey, velvety underneath.

TUNIS AND PERSIAN DATE PLANTS.

HAVING a large number of Tunis and Persian Date plants ready for planting, I request to know what possibility there is of their

being a success in a moist part of Tirhoot. This is a palm district, and many varieties do well.

I should be glad to hear if the date of commerce, *Phœnix dactylifera*, does well in any part of India, that is, does it produce marketable dates sufficient to pay expenses.

At the Lucknow Horticultural Gardens I believe they fruit yearly in the rains, and that the fruit rots on the plants, owing to the moisture, and does not come to perfection.

How do the plants answer in the Botanical Garden at Seebpore? I should be obliged if any of your numerous readers could give any information on the subject.

22nd May, 1888. J. B.

FOREST TOUR OF COOPER'S HILL STUDENTS.

WILL any of the late arrivals from Cooper's Hill College of Forestry be so very good as to give me particulars on the following points :—

(i). The time the tour through continental forests extends over, and the month in which it usually begins.

(ii). Probable cost of the tour, allowing for everything. I shall be very much obliged for any and all information which can be given, as I intend going home to attend the practical course next year.

"OLD FINCHLEIAN."

TRAINING OF CEYLON FOREST OFFICERS.—The *Ceylon Times* remarks :—"The recently appointed Foresters—Messrs. Tatham and Hansard—have just received instructions to proceed to the Indian School of Forestry at Dehra Dun, in the North-West Provinces, to study forestry there for eighteen months. All their expenses are to be paid by our Government, and they will receive salaries as well; so they are very lucky to be given this excellent opportunity of acquiring a scientific training in their work."

JJ. Review.

TIMBER AND SOME OF ITS DISEASES.

Mr. Marshall Ward's excellent papers on the diseases of timber have been continued in the number of "Nature" for the 31st May, and contain matter of the highest importance to Foresters, the wood-cuts showing the sections of wounds in trees being particularly clear and detailed.

He treats of the natural death of branches in a dense forest from want of nourishment, as they become deprived of sufficient light by the growth of the parent crown and of neighbouring trees, and the effects of breakages by snow, wind, or the fall of neighbouring trees are explained, as well as the attempts of nature to cover over a wound by the formation of a *callus*.

It is also shown that unless such wounds are properly closed, they afford access of parasitic spores to the tissues of the tree.

The question of interference to prevent this, is of course one of expense, but, if possible, broken branches should be cut off close to the stem in winter, and a clean cut made without tearing or crushing of the cortex or cambium, and the surface painted with tar, which kills any spores falling on it.

Mr. Marshall Ward's paper is continued in "Nature" of the 7th June, commencing with an account of *Canker*, the generic name of a number of diseases resulting from parasitic fungi attacking the exposed cortex, or cambium, when some small wound is imperfectly healed.

The well known '*Larch disease*' is taken as a type of *Canker*, and a full account of the development of the fungus *Peziza Willkommii*, which causes the disease, is given.

Mr. Marshall Ward remarks that the larch is an Alpine tree, growing naturally at an elevation of 3,000 to 6,000 feet above sea level and even more.

In its native heights the disease occurs, but does not become epidemic, as it does in the valleys and plains of Europe.

This affords another strong argument against attempting to grow exotic timber away from its proper soil and climate.

Regarding the conditions which favour larch disease, we read that whilst in the mountains, it is free from leaves till May, in the lowlands, it often begins to shoot at the end of March, or the beginning of April, and consequently the tender leaves and shoots are liable to the attacks of spring frosts, whilst the transition between winter and spring is very sudden on high slopes, and the leaves are rapidly formed without any check.

In warm damp valleys also, the tissues are softer and more watery, and more liable to damage by frost than the more compact tissues formed in mountains. The dry air of the mountains is also unfavorable to the development of the spores of the *Peziza*, even if they obtain a lodgment on the trees.

We look forward to further papers promised by Mr. Marshall Ward on this interesting subject.

RHEA FIBRE.—The Government of the French Republic has notified its intention of holding a competitive trial of machines and processes for the preparation of Ramie and Rhea fibre.

The competition will be held at Paris on the 15th August, 1888, and intending competitors should address 'Le Conseiller d'Etat, Directeur de l'Agriculture, Paris.'

CHURCHILL & SIM'S WOOD CIRCULAR,
MAY 4TH, 1888.

EAST INDIA TEAK.—The deliveries for the first four months of the year have been 6,192 loads against 3,294 in 1887, and for April 1,382 loads against 914 last year; and the stock, as will be seen, is 4,800 loads less than last year. All very satisfactory figures! The only danger is that shipments may become too large. At the present level of price there is little, if anything, to check consumption, and as most of the floating cargoes are disposed of, there is no reason to expect any pressure on this market for many months to come. Price current per load £8 to £13.

KAWRIE PINE.—The demand has decreased, and very few sales have been made. Price current per foot superficial 6*d.* to 9*d.*

EBONY.—*Ceylon.*—The demand is dull, and stocks are heavy and increasing as shipments continue much in excess of consumption. *Mauritius*—Small parcels of sizeable, sound wood might be sent, but there is sufficient stock of other sorts. *Madagascar* and *Macassar*—are inactive. Price current per ton, £6 to £14.

BOXWOOD.—*Persian.*—Stock is chiefly composed of small wood, for which there is not much demand. *African.*—There is a fair demand for good wood in small parcels. Price current per ton £3 to £12.

JUNE 6TH, 1888.

EAST INDIA TEAK.—The deliveries for May have been 742 loads, against 1,197 last year, and for the first five months 6,934 loads, against 4,491 last year. The demand has been less active during the past few weeks, falling chiefly upon planks. The prospects for the latter are not quite so promising, the extra price they have commanded threatening to over-stimulate the production. Quotations both for logs and planks have remained unaltered since our last report with rather more difficulty in selling.

EBONY.—*Ceylon*—continues depressed; prime, large wood is firmly held, but no sales are being made, and to clear inferior parcels low prices have to be accepted, as the demand has not improved.

Prices unchanged since former Circular.

IV. Notes, Queries and Extracts.

Sketch of the Forestry of West Africa, with Particular Reference to its Present Principal Commercial Products.*—This work is offered as a humble contribution by the author, commemorative of the Jubilee of Her Most Gracious Majesty the Queen. He happily dedicates it to his wife, out of consideration of the self-sacrifice she exhibited in foregoing the society of her husband during the compilation of the work, which was carried out in his leisure hours.

It is a work treating of the forestry of West Africa, but in practice it reaches far beyond this line, and embraces a large part of the vegetable products of the colony, exhibiting some interesting side lights on the manners, customs, trading characteristics &c., of the inhabitants.

In reviewing the work for this *Journal* we shall, of course, confine ourselves to forestry and details strictly bearing upon timber.

Like most tropical countries the west coast of Africa produces an abundance of palm trees and dense or hard-wooded trees, mostly of the leguminous order, an order of which the laburnum, familiar to us in England, is a member. As a natural consequence the wood is mainly small in character. The African oak or teak (*Oldfieldia Africana*) is abundant in Sierra Leone and Upper Gambia, producing timber trees of good quality 15 feet in circumference of stem. Other trees are noted 10 to 12 feet in circumference; but, although the vegetation is vast, the great volume of the wood is small in diameter. Nevertheless the author does not endorse the description given of the country by pessimists and disparagers as the land of "bush." He quotes from Butter Sheet a description of a West African forest:—

"So vast is this vegetable kingdom, that the animal world sickens and dies out before it—this immense forest holds scarcely a living creature. For months I have trodden its labyrinths, and seen only a diminutive deer, a grey monkey, and a few serpents."

* By Alfred Moloney, C.M.G., of the Government of the Colony of Lagos. (London: Sampson Low, Marston, Searle, and Rivington, 1887).

A curious system appears to obtain in these settlements, inasmuch as the farmers are partially nomadic, moving from one district or farm to another as the land becomes impoverished or exhausted; as a natural consequence these exhausted farms become features in the landscapes. Our author says:—

"Land is worked on an average ten years, after which it is deserted for virgin soil. This period is made up as follows:—four or five years continuously after clearage by cultivation and harvest, two or three years to lie fallow, and the balance of the time to re-cultivation and fresh harvest, when the land is considered by the people as worn out."

This system has a direct bearing on the forest growths of the country, and clearing by axe and fire is constantly going on, added to which, from ignorance or indifference, trees of great commercial or economic value are largely destroyed.

It seems an ordinance that where the European sets his foot, his first office is to destroy the native timber. This example is speedily followed by the native races, who upon imbibing the first rudiments of civilisation, in the shape of cultivating the soil, immediately fall foul upon their native forests. Timber is a slow and unproductive crop, and must give way to plants that yield their returns in one season.

It is easy to see that as centuries roll on the natural covering of the earth disappears, and the climates become more dry, and the land more arid.

Our author informs us that the islands of St. Helena and Ascension are now denuded of their indigenous timber, and that the native trees remaining are of small dimensions, the foreign element being next to nothing and undeveloped.

"St. Helena was discovered by a Portuguese, Jean de Noya, in 1501; at that date it was entirely covered with forests, the trees drooping over the tremendous precipices that overhung the sea. Now nearly the whole of the indigenous vegetation has disappeared, except on the upper part of the central ridge, and is only very partially replaced by introduced plants, in consequence of the soil being washed off from its rocky foundation since the destruction of its forests."

"In South Africa, according to Colonial botanists' reports, millions of acres have been made desert, and more are being made desert annually through the destruction of the indigenous forests. In Demerara the useful timber trees have all been removed from accessible regions, and no care and thought given to planting others. From Trinidad we have the same story; in New Zealand,

there is not a good Kundi pine to be found near the coast, and I believe the annals of almost every English colony would repeat the tale of wilful, wanton waste and improvidence."

Our author says, "It can be stated, without fear of contradiction, that in our possessions on the coast of Africa the timber is rapidly and visibly diminishing, and that the adoption of steps for replanting and preventing waste has become worthy of early consideration." "It would be no hardship, and would prove highly advantageous, to impose as one of the conditions of lease, that in clearances for farm purposes, certain trees of known value should be uninjured, as far as practicable, either by axe or by fire."

One source of great destruction to the native timber is the supply of firewood, for which purpose the mangrove, a tree highly valuable for its sanitary qualities, is largely drawn upon. Firewood is difficult to secure in some districts, and is consequently becoming dear.

The pages of this book are eloquent in pleas for the preservation of forests as sources of wealth and of benefit to the climates wherever they are situate, and they are equally rich in regrets that the study of forestry is so much neglected in our schools. On this subject Sir Joseph Hooker is quoted as follows :—

"Forestry, a subject so utterly neglected in this country that we are forced to send all candidates for Government appointments in India to France and Germany for instruction, both in theory and practice, holds on the Continent an honourable, and even a distinguished, place amongst the branches of a liberal education. In the estimation of an average Briton, forests are of infinitely less importance than the game they shelter, and it is not long since the wanton destruction of a fine young tree was considered a venial offence compared with the snaring of pheasant or rabbit."

In the early pages of the work under review we find allusion to the home Government making official enquiries as to the capabilities of the colonies dependent on the British Crown in supplying timber for shipbuilding, railway works, general building, furniture, lathwood, &c. This was in the form of a circular despatch, dated June, 1874, emanating from the Commissioner of Woods and Forests. We there learn that like enquiries were made in the same year by the Foreign Office, through Her Majesty's representatives abroad, and that the result was compiled in the following year. These inquiries do not seem to have borne much fruit, as the Gambia and St. Helena alone responded. In the former, mahogany for shipbuilding is noticed ; rosewood and blackstick for boat and canoe building, the male species of "runs" for bridge and house building, mangrove for props, posts, and small vessels, black ditto for build-

ing native houses, cotton tree for canoes, and domestic utensils, &c. The forests are noted as being owned by the Government, and to be diminishing, owing to the operations of wood-cutters, that restrictive ordinances with regard to felling trees were in contemplation, and that the export trade in timber ceased with the introduction of iron in shipbuilding.

In the West African Settlements, as a whole, the export trade in timber still exists; but it is strange that France is a better market for the wood than England. One branch of this wood trade is dye woods, such as camwood, barwood, and red sandalwood, of which about 3,000 tons, value £15,000, were shipped to the United Kingdom in 1878, since which date the trade has declined owing to the increased use of dyes produced from coal tar-refuse.

From the Gaboon it is estimated that 40,000 tons of sandalwood and ebony are annually exported.

Mr. G. S. Saunders and Messrs. Gardner & Sons of London, who are associated with this West African wood trade, appear to have contributed valuable information to the author. From these sources we learn that barwood realises in London from £2 10*s.* to £4, or £2 15*s.* to £4 5*s.* per ton. This wood, besides its use in the dyeing trade, is worked up in Sheffield for knife handles, &c.

Camwood is extremely valuable, as it ranges from £29 to £35 per ton; black ebony from £4 10*s.* to £13 per ton, according to size, colour, and freedom from defects.

Our author writes:—

"Although West Africa has ceased—let us hope only temporarily—to form one of the timber centres as regards export trade, an extensive and important local timber industry proceeds, partly in the building of canoes and cutters for the river trades, and partly in the substitution of framed wood for mud and wattle houses along the coast line."

The prices of West African woods when they reach this country, mostly by steamers plying to Liverpool, appear very high, but it is a fact that with close application, with the view of developing the trade, a great advance in the direction of cheapening their cost might be made, for we learn that the finest of the woods, such as mahogany, rosewood, good hard and beautiful woods, &c., could be purchased at the Gambia at 2*d.* per foot (super. 1 inch thick). A list of many useful woods is given, in which the local prices under existing circumstances range from 1*d.* to 6*d.* per super. foot 1 inch thick.

The detailed particulars of the different kinds of wood produced by these West African Colonies and Protectorates are not very

lucid, and the index, which is a mere skeleton of the contents, does not render much assistance. For instance, if you turn to oak or mahogany you find neither, and any notice thereon has to be found in the text in the best way it can. The reviewer remembers, in reading the book, coming across a beautiful description of a tropical forest. He failed to note the page, and he has sought for it again and again in vain. A defective index is a great drawback to any publication, especially of the text-book type, of which the work under notice is no mean example.

The description of African oak or African teak is drawn from Lindley and Moore's "Treasury of Botany," and is very brief.

Of African mahogany we have the following note, bearing date 1832 :—"Fifteen years ago it was not known that mahogany grew in the Gambia. Since that period several thousand loads have been shipped to England from our settlements on that river, and although the natives would not at first prepare it for shipment, they are now willing to supply any quantity that may be required. This is the *cail-cedra* or mahogany tree of the Gambia (*Khayer senegalensis Juss*), a lofty tree, the wood of which is adapted for building, carpentry and joinery, and for turning.

Of other woods there are incidental notices, but they are not of that detailed nature that timber merchants would wish.

Amongst curiousities of timber we may note a shipbuilding and carpentry wood exported from Sierra Leone called "Pissaman," that is proof against the attack of marine animals ; another wood, called mool, the produce of a tree that yields vegetable butter; whilst another, bearing in Lagos the name of "Oroko," resists for years the destructive action of the "white ant." Perhaps the most curious is a member of the Screwpine family, the *Fanjahnee* (Mandingo) of the Gambia, or self-fire-consuming tree, abundant in Upper Gambia. The natives assert that the fruit, when matured, bursts, causing spontaneous combustion, which often destroys the tree and desolates the site. No Mandingo would have such a tree in his compound as it is more treacherous than a firestick.

Lastly, we may note the Mozambiti lignum vitæ, a large tree, the wood of which is dense, close-grained, and very heavy, with a deep reddish-brown heartwood and a light sapwood. The ash left on burning the wood is used by the Portuguese as white-wash for houses, and by the natives to reduce the acidity of the native tamarind pulp.

This particular coast affords a reflex of man in his primitive state in the veneration in which large trees are held by the natives, and the consequent immunity they enjoy from the destructive action of

the axe. This feature is most prominent in the Yoruba country, where it refers to the *Oroko*, *Afon*, *Araba*, *Ashori*, and other large trees.

A most interesting side of the timber question is the requirements for wood in a raw and manufactured state from outside sources, which is growing upon those colonies. These are very ably dealt with by the author, who seems to write in a tone of regret that the requirements are not met by local means, although it is clear that, without this augmentation, the country is being rapidly denuded of its natural growth of wood for home consumption.

We find that Sweden figures prominently in this import trade.

Mr. Dering, reporting on the Forestry of Sweden and Norway, says :—

"There is hardly a maritime country in the world, with the exception of China and Japan, to which the produce of Swedish forests does not appear to find its way."

Our author says, "Swedish and Norwegian vessels regularly find their way to this coast." Statistics are given for 1872 ; but as they apply to the whole or our African possessions, they are of very little value when applied to the west coast only. Deals and planks, planed boards, and beams and spars, are the principal articles shipped ; but a good deal, no doubt, reaches the coast, more or less in a manufactured state, from Great Britain.

A considerable import of staves and empty casks is carried on, and we find in 1885 as follows :—

Staves and empty casks,	Foreign, ...	...	£62,300
„ „ „	British, ...	...	15,966
Wood unenumerated,	Foreign, ...	...	13,545

The Americans do a considerable trade along the West Coast of Africa, mostly in wrought or manufactured wood, reference to statistics of which are given. Our author says :—"Here, as elsewhere, along this coast, American trade insinuates itself, whether in wooden gimcracks, furniture, rum or tobacco," and again, "A regular export, however, to West Africa of timber proceeds from the United States of America."

The work under notice is one of considerable interest in connection with forestry and the wood trade, as well as with other and kindred subjects, and is a welcome addition as a standard work to those particular branches of literature. We have no doubt it will meet with an active sale, and find a place in every library and collection of practical works bearing upon the trade and development of our colonies and dependencies.

We compliment the author upon his work, which must have been one of enormous labour and no little cost.—*Timber Trades Journal.*

THE GREAT NOVA SCOTIA RAFT.—When we last week again drew attention to the monster raft which left Nova Scotia on the 5th inst. for New York, we excused the brevity of our comments on the speculation till we knew whether or no the huge quantity of timber chained together would reach its destination or come to grief, as we had our apprehensions of the adventure being a risky one, and, as many expected, it has so far come to grief that it is adrift on the open ocean, entirely at the control of the elements. An easterly gale sprang up on Sunday, the 18th, and in latitude 40 deg. 16 min., long. 70, the tow line parted, and the raft was lost, and when last seen was drifting in a southerly direction.

In the accounts of the disaster yet to hand no mention is made of the steersman—or was there none? If so, the voyage must have been hopeless from the first, as in a contrary wind or a cross current it would be impossible to keep an elongated mass of material as this presented from coming athwart without something in the shape of a helm. The towing appears to have been set down as too easy a job, and it is evident proper provision was not made to meet one of the land gales, or rather hurricanes, which are so frequently encountered along the Atlantic coast.

If it was worth while to build a raft on such a gigantic scale, it was certainly false economy to put it under the management of one steamer. This vessel, called the *Miranda*, may have been of sufficient power to have towed the raft, but when the connection was severed by the parting of the tow line, all control was gone till the gale subsided, and the chance of clawing hold of this floating island of wood with seas running mountains high became no light undertaking. The catastrophe might have assumed a less serious form had two tugs been employed, as when one line parted there would have been the other holding on, affording time for the other to again lend her help.

We shall not be a bit surprised, however, to hear that the *Miranda* has again picked up the raft, which, of course, in fulfilment of her contract, she will go in search of directly the gale moderates. One would have thought that a prudent commander, as soon as his line parted, would have run down to leeward of the sea-washed mass, and there ridden out the storm in comparative comfort, the huge pile of timber forming a splendid breakwater.

In severe gales, where there is danger of a ship straining, it is not unusual for those in charge to get all the spare spars lashed together and launch them overboard, secure with a strong line, and allow the ship to drift to leeward, slacking up till the spars or raft is sufficiently far to windward to break the force of the sea.

We cannot understand why in the storm the *Miranda* continued to tow; she should have slacked up and saved the strain on her cables, keeping as near the raft as she safely could; but, of course, there may have been circumstances of which we know nothing that made it expedient for the steamer to look to her own safety, and, perhaps, after all, it was a case of abandoning the raft instead of the tow ropes parting. This view has some colouring in it from the fact that a United States man-of-war is said to have been sent in search of the "raft," but if the *Miranda* had not broken down we cannot see why she was not quite as capable of looking after the raft as any other vessel.

In 1792 a raft containing about 1,000 tons of timber was built at Swan Island, in the Kennebec, by Dr. Tupper, a somewhat noted eccentric character. It was made by tree-nailing square timber together in the form of a ship's hull, and was ship-rigged, the intention being to send her across to England. At that time no manufactured lumber was admitted to the ports of Great Britain; hence the timber in the raft was simply squared with the axe, to make it stow well. The ship or raft lay at Bath for some time, it being difficult to get men to go in her. She finally went to sea, however, carrying a small vessel on her deck. But off the Labrador coast her crew became frightened by bad weather and abandoned her. She was afterwards boarded by men from a passing vessel and found to be in good order, and it was suspected that she was deserted without sufficient cause. Two other similar attempts were made from the Kennebec, and both vessels went safely across, but foundered on the English coast, under the same suspicions of fraud as in the case of the Tupper ship. In 1825 the ship *Baron of Renfrew* was launched at Quebec, having made a previous unsuccessful attempt, when she stopped on her way, owing to the grease being consumed by fire from friction. She was towed down to the island of Orleans and anchored. Her dimensions are given as follows:—Length, 309 feet; breadth, 60 feet; depth, 38 internally and 57 externally; tonnage, 5,888 tons; draft when launched, 24 feet; cargo on board when launched, 4,000 tons of timber. She was ship-rigged, with four masts, and was perfectly flat bottom, with a keel of about 12 inches, wall sided, sharp forward and rather lean aft, and looked more like a block of

buildings than a ship. She sailed in August, 1825, drawing 36 feet of water, in command of a Scotchman, a half-pay lieutenant in the British navy. October 27th the *Baron of Renfrew* drove on shore on the coast of France, near Calais, and went to pieces.

It is evident there are too many contingencies attached to rafting timber across the ocean to make it probable that any such method of transport will ever become general even if this Nova Scotia raft ultimately reaches its destination.

For the information of those of our readers who may not have retained the particulars we gave of this extraordinary structure, we may mention that the raft consists of 27,000 trees, bound together by a series of chains which connect those around the outer edges with a larger central chain, running lengthwise along the mass. The shape of the raft resembled that of a cigar, its length being 560 feet, greatest diameter 65 feet, the weight of the raft being 11,000 tons. The total cost of the raft, including timber, construction, and transportation, is about $30,000. The raft has the capacity of 70 large schooners, and the usual freight charges alone for this amount of timber are $25,000. Two other rafts of the same size are now being built in Nova Scotia.

This mighty mass of timber, though estimated by some of our American contemporaries to be equal in weight and dimensions to the still "living," but not for long, wonder of the world, the *Great Eastern*, falls far short of the bulk and capacity of that Leviathan steamship, and we are well within the mark when we state that the big steam vessel could stow all the trees in the Nova Scotia raft and a score of big shiploads besides, her burden being 22,000 tons, and her length 700 feet, and breadth over all 87 feet. The raft, it will be observed, falls far short of this, and is a long way removed from exceeding the largest ship afloat, one of Her Majesty's ironclad fleet, the *Northumberland*, being over 12,000 tons, if we take the actual burden, which in comparing with a raft of solid timber it is only fair to do. Those who have been out at sea in bad weather will fully understand the magnitude of the task the shippers of this huge mass of timber undertook, and those who have invested in the venture will wait with bated breath the news which passing vessels which have sighted the floating mass will bring. To vessels ignorant of its composition the first sight will lead them to the conclusion that they must have got out of their reckoning, whilst some amongst the superstitious might think that they had met with the great sea serpent at last. It will not surprise us to hear some more legends of that great unknown animal conveyed to us by those whose glasses have been pointed in the

direction of the "raft," when the weather was misty or a gale blowing that gave them no opportunity of taking more than a flying look.—*Timber Trades Journal.*

Upper Burma Forest Leases.—While attention is being drawn to the settlement by the Government of India of the various claims brought by creditors of ex-King Theebaw, it may be well to recall the circumstances under which the Bombay Burma Trading Corporation, Limited, obtained the concessions referred to by Sir John Gorst in his reply to Dr. Hunter, as reported in the *Times* on the 5th instant.

This Company had for a series of years worked the principal forests under leases renewed from time to time. The earliest of those leases, of which any account must be taken, began in 1881, and expired in November 1884. According to the terms of this lease, the Corporation enjoyed the sole right of removing teak timber from the King's forests into foreign territory. The rates to be paid by the Corporation for such logs as had been cut and worked out by the King's own people are stated in the contract, as well as the royalties to be charged on the logs worked out by the Corporation itself. The schedules of rates include all possible sizes and qualities of logs, full-sized and under-sized, long and short; but apparently nothing under 12 cubits (18 feet) in length was bargained for.

A question arose as to the right of the Corporation to reject any timber under the terms of this lease, and to settle the dispute a supplementary contract was entered into in July 1882, to come into force in November, and to continue till November 1887, allowing the Corporation to cut and remove as many logs as they chose provided these measured under 18 feet in length (any girth), or were under 4½ feet in girth (any length).

Under this contract, called the "Shorts," a lump sum of Rs. 1,00,000 had to be paid annually by the Corporation. Now it is manifest from the wording of the original lease that the Corporation had no right to reject any logs on the ground of their being under 4½ feet in girth, and to those who know anything of the Burma teak trade it must seem surprising that payment for full-sized short logs (under 18 feet in length and over 4½ feet in girth) was not provided for at all. There is an unexplained mystery about this "Shorts" lease, for while the Corporation's agent, Mr. S. Jones, declared that it had been forced upon his firm, "in order to extract money," the Burmese held that under the original lease

there was no such thing as rejected timber. (*See* correspondence in Burma Blue Book).

It may not be possible now to discover at whose door lies the credit or the blame, but there can be no doubt that the omission from the first lease of short full-sized logs (*i.e.*, full-sized in girth), which led to the subsequent agreement, was a distinct advantage to the Corporation. Some of the largest and most valuable pieces of teak that reach Moulmein and Rangoon measure less than 18 feet in length, trees of large diameter having in many cases to be cut into short lengths to enable the elephants to drag them. Apart from those logs which the foresters are obliged to cut short, there must be a great temptation presented to the workers under such a lease to sacrifice a few inches in the length of "Hlaw" logs, on which a fixed royalty of Rs. 6-8 each was payable, in order to get them included in the "Shorts" contract. The complaint of Mr. Jones that this second contract was forced on them seems to indicate that the Bombay Burma Trading Corporation was obliged to agree to the terms in consequence of some other parties offering to compete with them for the working out of the large-sized short timber omitted from the first lease, and there was a report in Burma that such was really the case. A few months after the "Shorts" contract came into force, a third lease was arranged to take the place of the original one, expiring in October—November 1884. This too, like the second, was a lump sum contract, the amount payable annually being Rs. 3,50,000. When the quarrel arose between the Bombay Burma Trading Corporation and King Theebaw's Government, which resulted in the Burmese war, there were, therefore, two leases in force, which, for all intents and purposes, may be treated as one. Under this the Corporation had to pay yearly a sum of Rs. 4,50,000, and for that was allowed to cut and remove as many teak logs of any size as its foresters could.

All that has been said above refers to the Ningyan and Tounghoo forests, where the disputes arose. The Corporation, besides these, worked the Chindwin forests, and had agreed to pay for this concession from November 1887, a lump sum of Rs. 2,50,000 annually, so that for a yearly payment of Rs. 7,00,000 the Corporation claims under these leases to work all the principal teak forests in Upper Burma without let or hindrance until November 1892.

In deciding as to the claims of the Bombay Burma Trading Corporation, and as to the future working of the forests in Upper Burma, the Government of India has a most difficult task set be-

fore it. That this is felt to be the case by the authorities themselves may be gathered from the fact that the matter seems still to be under the consideration of Government.

As far back as November 1885, a memorial was addressed by Moulmein merchants and traders to the Chief Commissioner, and this was followed by one to Lord Dufferin when he visited Burma, early last year, signed by a large number of the leading firms in Rangoon, Moulmein, and various parts of India. In both of these the Government was strongly urged to abolish all existing leases and to place the working of the forests in the hands of the Forest Department, and it was suggested that any compensation found to be justly due to the leaseholders should take the form of a monetary payment. In the memorial to the Viceroy it was recommended that "the investigation into the claims of the leaseholders should be conducted openly by an influential commission of enquiry, with full powers to thoroughly sift all the evidence produced before it." Up to the present time no such investigation has been started, and there is a very general impression abroad in Burma that Government might find it somewhat inconvenient to carry through such an enquiry as the one proposed. We went to war because Theebaw insisted that his decree against the Corporation for breach of contract was not an arbitrary one, and refused to submit to the investigation proposed to him by the Viceroy.

What people on the spot, who are most deeply interested in the matter, want is just what Theebaw was deposed for refusing—a searching investigation into all the circumstances connected with the granting and working of the forest leases.

A letter published in the Burma Blue Book (1886), page 195, throws some light on the means adopted by the Corporation's agents to influence the Chief Commissioner on their behalf. The letter is attributed to Mr. Andreino, their Mandalay agent, but was evidently written by Mr. Louis Andrews, a German, and one of the Rangoon managers who had gone up to discuss matters with Mr. Andreino.

From this letter it is clear that the King's agent (at Rangoon) was a creature of Andreino's own making, and that his answer to Mr. Bernard's Secretary was a "diplomatic" answer put into his mouth to serve the purpose of the Kin Woon Minghee.

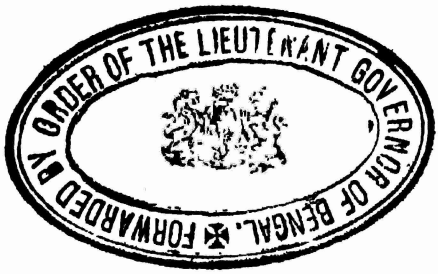
In the *Times* of the 13th July last it was reported from Calcutta that the Government of India had come to an arrangement with the Corporation, and that the leases were to be continued under fresh conditions. This may or may not be true, but if Government can take upon itself to vary the terms of Theebaw's

leases, why not go a little further and abolish them altogether? Nothing short of this will satisfy the other traders in teak.—TEAK.—*Timber Trades Journal.*

FLORAL BAROMETERS.—A remarkable little weather-wise plant is now said to be on exhibition at the Jubilee Flower Show just opened in Vienna. According to the account supplied by the proprietor of this natural curiosity it belongs to the family of the sensitive plants, but is so extremely meteorometric that it not only moves if touched, but will close its leaves forty-eight hours in advance of any change in the weather. It seems, moreover, to be the most catholic of barometers. For it foretells not only rain and wind, storms, and "set fair," but earthquakes and other subterranean movements.

There is, of course, nothing impossible in the assumption that a Mimosa has been discovered more sensitive than the species with which the world has so long been familiar. We are not aware that hitherto any of them have exhibited hygrometric qualities, though it is needless to remind the gardener that several well-known forms instantly fold up their leaves when touch is applied, and, on a tropical turf covered with them, will so rapidly transmit the movement to one another, that the pedestrian sees to his amazement a sort of wave of motion travelling ahead of him. For ages it has been an everyday piece of weather-wisdom that if the Siberian sow-thistle shuts at night the ensuing day will be fine, and that if it opens the sky will be overcast and the day rainy. If the common African marigold shuts at seven o'clock in the morning, there is a probability of rain being at hand. If the bindweed and the common marigold are already open, they will shut up at the approach of rain, while the pimpernel is so notoriously sensitive to any excess of moisture in the air that it has received the name of "the poor man's weather-glass." It is a familiar fact to students of vegetable physiology that the leaves of *Porleria hygrometrica* fold down or rise up in accordance with the state of the atmosphere. The leaves of the Hœdysarums have been well known, ever since the days of Linnæus, to suddenly begin to quiver, without any apparent cause, and just as suddenly to stop. Force cannot initiate the movement, though cold will stop it, and warmth will set in action again the suspended animation of the leaves. If artificially kept from moving, they will, when released, instantly begin their monotonous task anew, and, as if to make up for lost time, will dance with redoubled energy. The lower petal of some

orchids manifests similar spontaneous movements, the nature of which is more mysterious than the tendency of the compass plant of the Western prairies to present the edges of its leaves north and south, while their faces are turned east and west. The leaves of the *Colocasia esculenta*—the Tara of the Sandwich Islands—will often shiver at irregular times of the day and night, independently of the wind or any external cause which can be detected by our rude senses, and with such energy that little bells hung on the plant tinkle. These, and many similar cases of something akin in appearance to spasm or reflex action which will recur to the memory of a botanist, are not to be explained by the presence of any peculiarity in the structure of the plant, and even did an organism exist, the sensitiveness by which the motive organ is affected remains as mysterious as ever. Such a structure has been described in the sensitive plants—whose activity, it is also said, may be paralysed by the vapour of chloroform—but we believe the keenest eye has not as yet been able to detect in the species just named any similar peculiarity capable of accounting for these strange motions. The chances, therefore, are that they are due to changes in the weather of such a slight character that our nerves are incapable of appreciating them, or the mercury of recording their accompanying oscillations. It is, indeed, this extreme sensitiveness to atmospheric conditions, and more particularly to light, which causes certain plants to close, not only when there is a shower on hand, but at particular hours of the day. "Floral Clocks" can thus be made by planting flowers in a circle according to the well-ascertained times of their waking and going to sleep.—*Pioneer.*



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THE FORESTS OF MANIPUR.

(*Continued from page* 299).

To the south of the Cachar-Manipur road, in the forests that contain the India-rubber, the nagesar (*Messua ferrea*) abounds, and a small trade is done by the hill tribes in collecting its medicinal flower-buds. Along with nagesar one or two species of Eugenia are occasionally met with; and the járúl (*Lagerstræmia Flos-reginæ*) is in great abundance, and with it the equally plentiful tún (*Cedrela Tuna*). These useful trees ought to furnish the planters of Cachar with a never-failing supply of admirable tea-box wood but for the difficulty of removal. I cannot enumerate all the bushes and herbs seen in these forests; ferns and dwarf palms form a dense under-vegetation, while every bough overhead carries its profusion of epiphytic orchids. In exposed situations the tropical Cassias abound—*C. Fistula* in the forests; and *C. occidentalis*, *C. Sophora*, and *C. Tora* forming gregarious clumps in the open jungle. The general tone of the vegetation recalls, in fact, the warm, damp forests of South-eastern Bengal, devoid only of the cocoa-nut, betel-nut and palmyra palms, while every now and then the appearance of strangers bespeaks the border-land of a perfectly distinct area, the Malayan—such, for example, as the many plants belonging to the *Melastomaceæ*, *Ternstræmiaceæ*, and *Guttiferæ* natural orders. In the Kala Naga forests the wild elephant is also fairly plentiful, and the Manipuris sometimes combine and hunt for the precious ivory—a demand that is rapidly exterminating the monster of the forests from Southern Asia. Far away on the eastern side of Manipur recent foot-prints of a herd of elephants were met with, but practically the Manipur stock

is confined to the southern Jírí forests bordering on the Lushai country.

But I must hasten forward, as there are still some 70 miles to traverse before the valley of Manipur is reached. After having marched through some five or six miles of damp dense forest, the path improves with the ascent to the Godamghát outpost. Formerly about half-a-dozen Manipur soldiers used to be retained here; but owing to the unhealthiness of the station they were removed. After leaving Godamghát the last view is got of the Jírí river, and its dense evergreen forests stretching far to the left. A new country is entered on the ascent of the Múkrú range. The soil is dry and rich, and the forest changes completely its character. A few trees of nagesar continue, but soon become intermixed, in dank shady glades, with the graceful rounded clumps of the fig (*Ficus triloba*), the large leaves of which, with their ferruginous velvety surfaces, are truly lovely. On dry grassy slopes and on the more open forest tracts, another fig is met with (*Ficus conglobata*). This tree, throwing towards the ground its fruiting boughs succeeds, through the aid apparently of ants, in having its fruits completely covered with the loose rich soil in which they are ripened. On the boughs of this tree a curious bee was found which, ant-like, had constructed its hive by sewing two or three leaves together. The insect was very small, and had a curious greenish metallic lustre. Thinking this to be an ant that perhaps preyed upon the smaller species, supplied with food by the fig in return for services rendered, I was about to catch hold of it, when one of my coolies told me not to do so, as the bee stung very badly at first, but lost this power after a time. This local wisdom dictated a course of procedure that greatly astonished me. The hive was struck gently with a stick once or twice, the adventurer rushing off as hard as he could between each attack. By-and-bye, deeming that the bees had got over their fit of ill nature, he coolly went up and cut the hive off the tree—the bees crawling over his hands all the time without stinging him.

In the forest above, the Mukru (*Schima Wallichii*) makes its appearance—a tree 30 to 60 feet in height, which when in full flower, looks remarkably like a tea tree. It is indeed a closely allied plant to the Camellia; and along with *Saurauja Roxburghii*, observed lower down, may be viewed as establishing the Ternstrœmiaceous character of the Manipur forest, which becomes more and more pronounced, until in the eastern ranges, forests of the true tea plant are met with. *Schima Wallichii* is an extremely variable plant, and a well-marked form of it (*S. Noronhæ*, Reinw.)

fully deserves, in my opinion, the independent position once assigned to it. This form may be said to make its appearance in Northern Assam and the Khasia hills, and to spread east and south through Manipur to Northern Burma, and thence to Penang, Borneo, and Sumatra. It may readily be distinguished by its thicker, more coriaceous leaves, shining green above, felted canescent or shortly tomentose below, with the midrib hairy. Venation quite obscured, margin more or less crenate or sometimes almost quite entire. Flowers less than one inch in diameter. I would refer to this type *Gordonia mollis*, Wall., *G. floribunda*, Wall., *Schima mollis*, Dyer, and *S. oblata*, Kurz; but I would place *Gordonia oblata*, Roxb. under *Schima crenata*, Korth., a Malayan species. In part confirmation of this re-arrangement, there exists on Roxburgh's original drawing of *G. oblata*, a note to the effect that the specimen figured by him was obtained from Penang. Few genera have species blending into each other more completely than do those of *Schima*. If *S. crenata* be not retained as distinct, then *it*, together with *S. Noronhæ*, must be thrown into an artificial species, which might perhaps bear the name of *S. Wallichii*. To the north a still more marked variety of *S. Wallichii* (or rather of *S. Noronhæ*) was found, which perhaps deserves specific recognition. The shape, texture and venation of the leaves of this plant closely resemble those of Anneslea. The obsolete reticulations, through the succulent texture of the leaves of this plant, and of those of the form recognised as *S. Noronhæ*, at once separate the living plants of these forms from *S. Wallichii* on the one hand and *S. khasiana* on the other. As seen in the forests these trees are quite distinct, but it is scarcely possible to speak of them, as found in the herbarium, with the same degree of certainty. I was greatly astonished to find at a height of 2,000 to 3,000 feet in the Múkrú forest, a species of screw pine, probably *Pandanus furcatus*. This elegant plant was seen to raise its crown of spiny leaves on a long, delicate, erect stem, which gracefully curved in its efforts to carry its head above the dense under vegetation. Beneath, the pandanus a species of Tapistra (which I have in my diary named *T. Bakeriana*) made its appearance, and continued from the Múkrú forests throughout Manipur in all the forests above 4,000 feet in altitude. This is in fact the most abundant Liliaceous plant in the State.

Descending the Múkrú range to the east, the river of that name is reached which is seen to flow in a southerly direction. This is a large clear stream of perhaps 40 yards in breadth. *Mahsír* fish were observed moving sleepily about in its deep pools, but refused either spoon or any other tackle. A rich harvest was, however

made in butterflies. These swarmed in myriads, especially four or five species of swallow-tails. A white butterfly was seen in great profusion, but always flying down the stream in lines perhaps 40 or 50 deep, following one after the other in so compact a manner that an expert swing of the net would often secure the whole string. On ascending the opposite slopes these curious insects were noted to be flying up the valley singly, fluttering here and there from flower to flower, as they worked their way up the gorge, to rush down the stream again in detachments apparently in a playful manner.

A volume might be written on the herbs and shrubs collected in this deep dark gorge. Ferns were in great abundance, and a species of Piper mingled its deep green ternately-veined leaves on the rocks with the leaves (also ternate-veined) of herbaceous and bushy melastomaceous plants—*Sonerila tenera*, Roxb., *S. maculata*, Roxb. and *Sarcopyramis nepalensis*, Wall. With the ascent from the Múkrú, the task of climbing the Kala Naga range practically commences. The forest and jungle is at first dense, but gradually becomes open, until the clearances around villages are reached. Studded here and there along this range are the village sites of the Koupuí Nagas, an extremely primitive race of people, who have been gradually expelled from their ancestral homes, to their present haunts, by the invasions of the Kukís from the country to the south. From the summit of the Kala Naga range a magnificent view is obtained of the country around. Far away to the west are seen the plains of Cachar, with the great Barak river winding among the hilly knolls that have been appropriated by the tea-planter. At the visitor's feet in the deep gorge below runs the sullen stream of the Múkrú, and stretching away beyond are the dark evergreen forests of the Jírí. East the eye wanders over a series of mountain ranges which enclose the Irang river, and which rise higher and higher until they culminate in the Limatol range, which overlooks the valley of Manipur, some 25 miles distant.

Continuing the road a descent is made to the upper reaches of the Barak, a stream fully 60 yards wide, stocked with fish, and having all the appearance of being likely to prove a rich field for the angler. Opening every now and then into deep pools, it is broken by gentle rapids, while the forest trees and bamboos throw the desired degree of shade without impeding the operations of the sportsman. From the Barak the path again ascends, and for a time skirts along the Irang river, where one or two charming bits of forest and wild rocky scenery occur, with refreshing water-

falls rushing below the traveller's feet. By the bed of one of these rivulets the rocks were found clothed with clumps of a beautiful Colocasia, the dark variegated foliage of which recalled the gardener's efforts with the allied genus Caladium.

To a large extent the forests over the regions rapidly sketched consist of *Schima* and *Saurauja* trees—the former with their single camellia-like white blossoms contrasting elegantly with the wax-like pink flowers of the *Saurauja* bushes. Several of these *Sauraujas* have large beautiful leaves densely matted with a russet tomentum, and having a profusion of veins that recall the *Dillenias* of the lower forests, while in their clump-like habit they equally bring to mind the rhododendron forests of the higher regions. A species of *Eriobotrya*, probably *E. petiolata*, Hook. f., was very plentiful. *Hyptianthera stricta*, W. and A. (of the form named *angustifolia*) was also common, and along with this another Rubiaceous plant, *Adenosacme longifolia*, Wall. Of the last mentioned plant there are three readily recognisable forms. One which I have called the *type* has leaves acuminate and flowers few not dichotomously cymose; the second, *tomentosa*, is a distinct form with cordate leaves, the whole plant coarsely hairy and the calyx teeth glandular; the third form—*dichotoma*—is distinguished by a large and pronounced dichotomous inflorescence. In the darker parts of the forest the stunted bush, *Acranthera tomentosa*, Br., with its clusters of large rose-pink flowers was gathered—a plant discovered by Griffith in the Mishmi hills, and said to be found also on the Khasias. It is plentiful in the forests between the Barak and the Irang, and is without exception the most handsome plant in Manipur, and one well worthy of introduction into European cultivation. It is only about a foot-and-a-half high, has four or five large leaves about 8 or 10 inches long, with (hid below its graceful foliage) pendulous clusters of some 20 rose-pink flowers, each flower fully 2 inches in length. Along with this elegant plant were also gathered *Ophiorrhiza lurida*, Hook., *Saprosma ternatum*, Hook., *Wendlandia exserta*, DC., and *W. glabrata*, DC., all members of the family, *Rubiaceæ*, and all fairly plentiful and giving a new character to the under vegetation. Between the Barak and the Irang the road dips down into the valley of the Lengba, where *Schima Wallichii* is met with in great abundance, along with the *Scrophulariaceous* large tree *Wightia gigantea*, Wall., an uncommon plant found in the Central and Western Himalayas, Sikkim and Bhutan, and distributed to Java. A remarkable Sikkim type of vegetation gets more and more developed as the traveller wanders northwards along the western ranges of Manipur; and the appearance of so

striking a tree may be viewed as the most southern indication of this feature of the flora. But gradually the Sikkim type becomes established with the occurrence on the heights above the Irang, of *Aucuba himalaica*, a bush, which prior to my visit to Manipur, was supposed to be confined to Sikkim and Bhutan, and to be distributed to Japan. Manipur fills up the connecting link; for everywhere from the Limatol range at 4,000 feet to Saramoti at 10,000 feet, this large bush occurs bearing a north-easterly direction through the State.

From the Lengba the road works its way through the forests that skirt the western wall of the Irang basin, and having crossed this and descended to the bed of the river, it ascends the opposite side, until it reaches the cup-shaped valley of the Kowpóm. This may be described as the first of the extensive series of valleys into which every now and then Manipur expands. Kowpóm is in the rains a rice swamp of fertile soil, about 2,700 feet above the sea. In the winter, however, the temperature falls so low that ice forms on its marshes. On leaving this smiling valley the road skirts the northern side, and makes the ascent of the ridges which separate Kowpóm from the valley of the Limítak, a tributary stream of no great importance. From the presence of a species of *Castanopsis*, resembling an oak, these hills are generally called Pemberton's oak ranges. The oaks proper form a feature of the eastern and northern division of Manipur, but so far as I was able to judge, do not occur on the western outer ranges, although they are met with on the slopes of the Limatol facing the valley of Manipur, especially to the north. From the Limítak the road winds up the ascent of the last and loftiest range of the western division of Manipur, *viz.*, the Limatol; and as it passes the crest of the ridge, it is 4,900 feet in altitude. From this point a magnificent view of the great valley of Manipur is obtained, with its expanse of water to the south, the Lotak lake, and its forest to the north—the site of Impail the capital of the State.

(To be continued).

ANNUAL MEETING OF THE AMERICAN FORESTRY CONGRESS.

First Day's Proceedings.

Promptly at 10 o'clock in the morning President George W. Minier, of Illinois, called to order the sixth annual meeting of the American Forestry Congress. Considering the usual meagre at-

tendance on the opening days of all associations, a good representation was present, delegates appearing from all the principal States of the Union—from the Atlantic coast to the far west. Among those of prominence present were :—B. E. Fernow, of the National Department of Agriculture, Washington, D. C.; Leo Weltz, Commissioner, Ohio State Board of Forestry, Wilmington, O.; George W. Minier, President American Forestry Congress, and many others.

In opening the session President Minier stated briefly the objects of the Congress and gave a few events of its history since the first annual meeting six years ago. Although, first an organization of the United States alone, it had been broadened to embrace in reality the whole western hemisphere, and the name changed to the "American Congress of Forestry." While this action had been wise in some respects, it had had its disadvantages, as making the Congress international in its character apparently, precluded the hope of obtaining appropriations to defray its expenses, from either the United States or any other American Government.

On motion of B. E. Fernow it was decided that the papers of certain members absent and unable to be present be read and discussed.

"Area and Economic Value of the Forests of the United States," a very able paper by H. C. Putnam of Eau Claire, Wis., was read by the Secretary. Mr. Putnam, having had over thirty years' experience in the lumber and timber business, his views were considered of unusual importance by the Congress. The lumber men of the north-west, he said, were cutting the pine forests of that region at the rate of 800,000,000 feet a year. Fifteen years will see the great pine forests of Wisconsin obliterated as an article of commerce. Just so with the forests of Michigan, Minnesota and the whole north-west. The importance of legislation on this subject cannot be over-estimated. Care should be taken against the origination of the devastating forest fires. Officers should be appointed by the National or State Governments to look to this and see that the laws already in existence are enforced. The young trees should be protected in their growth where the larger are felled and cut up. It is easier to save a thousand young trees than to plant and nurture one. By proper care and discrimination, by proper legislation, these great forests can be preserved at their present acreage. But will the National Government or the States ever move? The slaughter goes unheeded onward year after year. If these forests are destroyed, the great rivers of the

north-west will in the dry season become less than babbling brooks instead of commercial waterways as they now are. History has proven this prophecy to be inevitable. As a nation we are rich in forest area. The 800 miles of coast of the Carolinas, Georgia, Florida, Alabama, Mississippi and Texas, extending inward an average of 100 miles, carries a valuable pine forest of both varieties. Just so with other portions of the country. Australia, China, Japan and the islands of the sea, on the other hand, have no timber of commercial value. Mexico has some, but at present it is almost inaccessible. Europe depends entirely upon us for many varieties of timber. Are we to be profligate of these great riches, or are we to lavish and destroy? Action by Congress, and laws to insure preservation of the growing timber are the only safeguards. But we must not wait too long.

Discussion.

Mr. Fernow opened the discussion on this paper. He thought the incentive to forestry legislation lay rather with State legislatures than with the National Congress. In Michigan a commission has already been appointed to suggest legislation in that direction. Other States should follow. In Canada the most encouragement had been received. There the proceedings of this Congress were printed without the inquiry being made whether the organization were Canadian or American. There the Government has conjointly with the timber men appointed "fire wardens," to look to the preservation of the forests from fires and secure enforcement of all the laws. The lumber men pay half his salary and the Government the other half. This man has the power of police officers. He can make arrests and in case of emergency can summon all citizens to his aid in the suppression of fire or enforcement of the law. In Michigan, alone, on the other hand, the forest fires have done a damage of over seven million dollars. Of course the States could do nothing in regard to the mountain regions and Government reservation. Congress would have to legislate on that subject. The manner in which the Government forests were devastated was shameful, yet laws should not be passed without the instrument to enforce them. A national commission or board should be appointed with the necessary powers. The present trouble was that, although in most States laws already existed for the protection of forests against fires, there were no commission or officers to look after their enforcement.

Prof. J. L. Budd remarked that he had been surprised when in Riga, Russia, some years ago to find that shiploads of pine were

being continually shipped from that point to the United States in large quantities. On the other hand the English have picked up nearly every black walnut log in the west and shipped it to England to be manufactured there. Speaking a little off the subject he wished to state right here for general information that in Iowa they had found that white pine was one of the best timbers to grow. Groves planted 18 years ago were now from 40 to 50 feet in height. No particular experiments had been made with red pine, but they seemed to flourish wherever planted and proved very ornamental. Observations made by the Iowa people had shown that white pine made the best growth of any tree in the State. Red pine probably came next, and it was followed by white spruce.

"Helps and Hindrances to Kansas Forestry," by W. S. Newlon, of Oswego, Kan., was the next paper read. The author stated that the people of Kansas in years gone by had done a great deal of grove and tree planting on their farms and around their orchards, fields and homes. These benevolent efforts were now giving a rich return. All that was needed in the future was intelligent discussion and agitation to stimulate in the mind of the masses a benevolent inspiration for forestry. The hindrances to forestry in Kansas were the great droughts, fires, birds and insects, and the consumption of the timber as rapidly as it grew. In the past the prairies of Kansas were burned annually and much timber destroyed in the course. In Indian territory particularly these fires still ravaged periodically. To prevent the frequent disastrous fires from railroad sparks, the funnels of the locomotives should be netted. Much timber too is needlessly squandered in Kansas in the construction of bridges and other public structures that should be composed entirely of stone. Wire fences, too, should be built rather than plank ones. A substitute for wood in railroad ties should also be adopted by the railroads. The demand for ties probably makes a greater inroad on our forests than any other one article. The laws of Kansas fail to protect certain birds from indescriminate slaughter because of the impression that they eat and peck fruit and perforate trees. While this to some extent is true, yet these same birds do incalculable good by preying on borers and other insects that attack the trees. A law of Kansas forbidding the growth of hedges to a height of over 4½ feet was also an unwise act. They should be allowed full scope. The roots of trees and herbage stop the circulation of water through the ground, and hold it from running off and away through the streams too rapidly. It is a well-known fact to close observers that fibrous roots hold water

like a sponge and will make a swamp anywhere. This fact materially affects the rainfall of a country. Trees by consuming effete carbonic acid and giving out oxygen are valuable as preventives of malaria and other diseases. As a matter of fact birds are indispensable to forestry. Without them all trees would be destroyed by the various insects. Despite them many trees in Kansas are destroyed by the borers, caterpillars, grass-hoppers, aphis and other pests. The English sparrow and other birds destroy all these insects. The birds should be appreciated and protected from injury.

Discussion.

Mr. Minier said he endorsed every word of the paper—particularly all that referred to birds. They were his particular pets.

Mr. Fernow said he was astonished to see so few birds, comparatively, in the United States. The woods of North America appear lifeless compared with the woods of Europe. Singing birds particularly are scarce here.

Mr. Brown thought there were plenty of birds here, but they rather frequented the prairie groves and prairies.

Mr. Allen did not agree with the paper on the assertion that the roots of trees stored up moisture. That was, he thought, a great fallacy. He believed, on the other hand, the roots afforded an exit of moisture from the ground by sucking it up in the tree from whence it passed through the limbs and foliage to the atmosphere. Some of the birds, too, which the paper praised, he found in Western Kansas to be a great pest, sticking their bills into fruit and creating great injury.

Mr Morgan, of Ontario, Canada, in reply to this, said there could be no roses without their thorns. The birds paid for all their damage. He thought, however, roots were a great preservative of moisture. They act as a sponge. Go several days after a heavy rain and take a network of the roots and you can squeeze water out of them.

Mr. Osborne thought it wonderful the amount of moisture trees draw up through their roots and distribute to the atmosphere—even where the soil is apparently dry. Experiments have proven that the roots penetrate to such a depth as to obtain plenty of moisture where there has been no rain for months. In Nebraska he found the planting of forests had attracted the birds.

Mr. Fernow said that experiments so far had given no direct knowledge in regard to the transpiration of water by means of the roots and branches of trees. It is certainly true that the amount

of evaporation through the roots and leaves is enormous, yet it should be borne in mind that the roots, penetrating a distance often of 20 feet or more, bring up the moisture that otherwise would never be available.

Mr. Budd said that a few years ago, in the Adirondacks, he walked through a forest in dry mid-summer where the moisture actually wet his feet. Afterwards he visited the same country; the forest was cleared away, and where once was moisture was now arid desert. The point lay in the fact that evaporation from open land was much more rapid than from the earth covered with forests. Scattering trees did not do so much proportionate good in this respect as several thousand acres, as forest conditions seemed to be necessary.

Mr. Fernow stated that in Prussia, where forestry was better understood, and an annual crop of timber felled the same as any other crop, great trouble was lately experienced in disposing of the supply, timber being imported in large quantities from Gallicia and Hungary. As to the metal railroad ties suggested in the paper, Mr. Fernow would say that the Mexican railways had this year laid 60,000 of them as substitutes for wooden ones.

Mr. Budd said no climate on earth had been so greatly modified within 50 years as the climate of this part of North America. The clearing of the forests has clearly had much to do in this direction. Let us cultivate timber on our own soil, and not bring it from British America or Russia.

Mr. Fernow agreed that the clearing of forests greatly affected the climate. Experiments had proven that the temperature of forests was 15° to 20° lower than the fields in summer. In fall and winter the difference was somewhat less. The humidity of the forests was from 3 to 10 and even 13 per cent. greater than in open air.

Mr. Minier stated that years ago, when surveying the Illinois Central railroad and the Illinois river, he made some observations regarding the rainfall. A single inch of rainfall on a single acre of ground amounted to 101 tons of water! He also insisted that fibrous roots, acting as sponges, absorb large quantities of water. It is also true that an enormous evaporation is constantly going on through this medium. There is considerable moisture in the atmosphere all the time—so much, indeed, that if all the water above us for 40 or 50 miles could be condensed at once there would no longer be any dispute about there once having been a flood. [Laughter.] Regarding the subject of metal ties, President Blackstone, of the Chicago and Alton railroad, had informed the speaker

that they proved too great an injury to the rolling stock to ever be adopted. Paper ties were the only substitute, Mr. Blackstone has asserted, and it required bass-wood or linden trees to make them. "As to the birds, there are but few of them that are not our particular friends. In April, May and June they prey on the insects that attack the trees. In July and August they ask a little compensation for labor, and I propose to plant enough that they may come and get their pay without any trouble." [Applause.]

The report of the "New England committee" was read by the Secretary. It stated that the efforts of the committee had been principally directed toward securing legislation for the prevention of forest fires. The State grange of Maine had seconded the efforts of the committee, and in that, as well as other New England States, the results had been encouraging. In Maine a bill had been passed establishing an "Arbor Day" for the general planting of trees.

The report of the "Arbor Day committee" was read in the shape of a letter from Prof. Northrup. In all States visited, he had met with flattering results, many of them having already passed a law creating an "arbor day."

"Forestry in Nebraska" was the subject of a letter of the Nebraska delegates. It stated that great efforts were being made to awaken the interest of the people of that State in forestry with partial success. Already the forests at the mountain sources of the great rivers of Nebraska were being cleared off to such an extent as to endanger irrigation of Nebraska lands and, unless decisive steps were taken, in a few years the North Platte and other important streams would, in mid-summer, dwindle to feeble brooks or become entirely dry. The State Agricultural and Horticultural Societies, too, were urging the passage of a law by the State establishing "forestry stations"—that is, the planting at certain distances apart of considerable groves to be preserved intact. The delegates were endeavouring to secure the adoption of forestry as a regular course of instruction in the schools.

Mr. Budd thought every agricultural college in the United States, particularly, should teach forestry, and Mr. Minier amended the sentiment by insisting that every common school also should give limited instruction on the subject.

Ex-senator Gillham, of Alton, spoke at length on the necessity of forestry organization in Illinois. In his part of the State many trees had been planted, and the result had been satisfactory. He urged the adoption of resolutions by the Congress requesting the various States to amend their laws and constitutions in such a way

as to exempt from taxation all lands planted in forests for a given time.

"Legislation necessary for the encouragement of Tree Planting in Illinois," was the subject of a paper by Fred. Grundy, of Illinois, which was read by the Secretary. The paper was very brief, and particularly urged the passage of legislative enactments to promote forest planting. It concluded with the draft of a bill which the author thought should be presented to the next legislature of Illinois. This bill provided that land upon which a certain number of trees were planted for timber culture should be exempt for a limited time from all taxation.

Senator Gillham stated at the conclusion of the paper that a bill similar to the one presented had been introduced by him in a former legislature, but had failed to pass on account of its unconstitutionality, the constitution of Illinois providing nothing but school and church property shall be exempt from taxation.

(*To be continued*).

PENSIONS AND FURLOUGH ALLOWANCES FOR THE UNCOVENANTED SERVICE.

We have read the debate in the House of Commons on Mr. King's motion "That it is inequitable and anomalous that privileges as regards leave and retirement should be refused to some classes of officers in the Uncovenanted Civil Service of India, which are enjoyed by others in similar circumstances; and that in view of the heavy fall in the value of the Rupee, the payment of pensions of retired European Uncovenanted officers in England at the official rate of exchange is no longer equitable," and we offer a few remarks on the debate as regards our own Department.

Mr. King made a most forcible and eloquent speech explaining that the present Uncovenanted Service of India has absorbed to itself several of the most important Departments of the Indian Administration, and that the leave rules and payments of furlough and pension in Rupees, however applicable they might have been in the early days of the service, when it was confined to "the Native peons who swept out the offices, and the junior clerks who copied letters and totalled up the figures of the Covenanted Civilians," were now completely inadequate.

There can be no doubt that hundreds of officers have been induced to enter the Public Works, Telegraph, Forest and Educational Departments in the hope that, after having devoted the best years of their life to the service of India, they might spend

their remaining years at home on a fixed sterling pension, as in the advertisements of Government for candidates for these services, the Rupee was referred to as equivalent to 2*s.*, and no one could possibly have foretold, 10 or 15 years ago, that it would only be worth 1*s.* 4*d.*, or even less. If Government wants the best English labour, it must pay English prices, and settle the question on an English basis.

Mr. King put the case very forcibly at the end of his speech, describing the pensioner as "watching the exchange rate with fear and trembling, moving from one house to another smaller one, giving up luxury after luxury, though to most of us they seem necessities, and one economy after another made, with a constant struggle to keep up the small insurance premium, by which alone his family can be kept from grovelling poverty."

Colonel Hill, who seconded the motion, spoke chiefly on behalf of Engineers, and explained that pension is merely deferred pay, and that salaries were fixed on a lower scale than they would be, if men had to make a future provision for themselves out of their salaries.

Sir J. Gorst cannot be said to have replied fairly to the arguments brought forward in favour of the motion. When he stated that in the Land Revenue and Judicial branch of the Uncovenanted Service, there were 139 Europeans only and 2,449 Natives of India, he omitted to mention that this branch is really intended by Government for Natives of India, and that in the Public Works, Telegraph, Educational and Forest Departments, by far the majority of the gazetted officers are Europeans, many of whom have been specially trained at home, and appointed by the Secretary of State.

When Sir J. Gorst endeavours to make this a matter as between Natives and Europeans, we entirely differ from him.

Those Natives of India, who pass into the services in England, and who might perhaps wish to settle in Europe after their services have expired, should receive sterling pensions, as well as Europeans, but those Natives who are appointed in India can have nothing whatever to do with sterling pensions. Several Natives of India are in the Covenanted Civil Service, and they will, we presume, receive pensions in sterling and not in Rupees.

It is clearly to the interest of India, that Europeans should not be encouraged to settle there after retirement with their families, adding to the number of claimants for posts, which should be chiefly held by Natives, but this is the direct result of inadequate pensions, as any one visiting our hill stations must at once recognize.

Sir J. Gorst spoke of the Covenanted Service, as recruited by competition at home, and stated that the Uncovenanted Service is mainly recruited without competition in India, omitting all mention of the home competition for the scientific departments of the Uncovenanted Service, and their expensive special education, costing from £600 to £900, after securing nominations, and before they can join their appointments in India.

Sir J. Gorst, in his reply, twice threatened the Services that any attempt to extend their privileges, might give rise to such action as might result in the distinction between Europeans and Natives being swept away, and admitting that the Public Works and Telegraph Departments had received exceptional favours, he was afraid that any further agitation would lead to levelling down.

This argument cannot prevent our urging our claims on the consideration of Government, the question as regards the present being chiefly one of justice to old servants, whose prospects of a comfortable retirement are blighted by the rate of exchange, and for the future, whether capable and energetic European officers can be tempted to India, if offered merely the same leave and pension allowances as to Natives of the country, whose homes are there. Those who consider that they have not been fairly treated, and heads of departments who wish to maintain their efficiency, will not be influenced by any such threats, in expressing their opinions on this subject.

In referring to the Native members of the Covenanted Service appointed in India, Sir J. Gorst omitted all mention of the fact that they draw only two-thirds of the salary of those appointed at home, and yet, when it is proposed to pay sterling pensions to hard-worked deserving European officers, he stigmatised it as an anomaly. Another fallacy of the Under Secretary of State's was that, in India the proportion of the pension to the pay was one-half higher than in almost any country in the world, and this, when Rs. 5,000 is paid as our maximum pension, except in certain favored cases, although the monthly pay of retiring officers may be Rs. 1,500 and more.

In the case of the writer, furlough taken after 16 years' service would be annually Rs. 6,000, or £400 at the present rate of exchange, whilst pension would only be Rs. 5,000, or, unless the rupee should be further depreciated, £333, out of which family pension fund and insurance, amounting to £100, have to be paid, leaving £233 as the reward of 26 years' of untiring service in India, when he retires after completing his 55th year.

During the debate, Mr. Courtney demurred to the Chancellor

of the Exchequer's admission that Uncovenanted Civil Servants suffered *great hardship* by the fall of the Rupee. He said that the purchasing power of the sovereign had increased, and that £400 would now purchase as much of the commodities of life as £500 did 20 years ago, so that although the man who was entitled to a pension of Rs. 5,000 would now only receive £400 instead of £500, he had nothing to complain of.

Now in the first place Rs. 5,000 at 1*s.* 4*d.* in the Rupee is £333 and not £400, and does Mr. Courtney mean to assert that school, doctor's and butcher's bills, rent, rates and taxes at home have gone down by £166 in every £500, or 33 per cent. in the last 20 years; if so, many of our officers would not defer taking furlough for 15 to 20 years, as is now frequently done, merely for want of means.

Some carefully worked up figures on home expenditure in these respects would be very interesting, and we doubt very much whether they would confirm Mr. Courtney's assertion.

Sir R. Lethbridge threw light on the question by explaining that there are many important posts in India, which cannot be filled by Natives of the country, nor by Covenanted Civilians. These are chiefly in the four departments we have already mentioned, and to which the country owes nearly as much of its progress, as to the Covenanted Civil Service. Now, as the Government of India considers sterling home allowances as absolutely necessary for its Covenanted Civilians, its Military and Medical officers and Chaplains, it seems very invidious that it should refuse such allowances to its Engineers, Educational, Telegraph and Forest officers.

Government has recently promised sterling pensions to the Lady Nurses just recruited from home, whilst it gives pensions in Rupees to men like Sir D. Brandis, Sir Leppoc Capel, Sir Alfred Croft and Sir Guilford Molesworth.

We have seen it stated that there is no hardship in our reduced pensions, as the Covenanted Service pay 4 per cent. of their salaries towards their pensions, while we do not contribute a Rupee towards our pensions.

It should, however, be remembered that these officers get £600 directly from the State, and only contribute towards £400 of their pensions, and that our salaries are not high enough to make our contributions towards pension sufficient to add more than say £100, which indeed all members of the Services would probably gladly agree to do.

The rate of exchange does not affect the amount of this contribution of the Covenanted Civilians, as they continue to pay the

same proportion of their pay now that the Rupee is at 1*s.* 4*d.*, as they did when it was at 2*s.*, and still get the exact sum of £400 added to their pensions.

We regret that Sir G. Campbell, Sir Richard Temple, and Sir G. O. Trevelyan, all of whom know well enough how matters stand with our services, should not have offered any explanation to the House, but should each have given a silent vote against Mr. King's motion, although they must know that public meetings of the members of the Uncovenanted Service would not have been held in all the principal towns in India without there being a real grievance demanding enquiry.

We maintain that as long as the Government of India finds it necessary to recruit men of European training for its scientific services, so long it will find its interest in encouraging furlough at regular intervals, by sterling home allowances, and early retirement, after a man has spent his best years in India, and that unless it can offer reasonable prospects of such indulgences, it had better cease recruiting in Europe, and content itself entirely with Native talent, as this will be better than that of the inferior Europeans, who may be tempted to come out to India, as soon as the determination of Government to refuse sterling home allowances is thoroughly understood in England.

The Ceylon Government has recently conceded pensions to its officers at rates of exchange which prevailed when each officer entered the service. This plan, although it might satisfy some of our older members, would be unfair to the future of our services, which demand sterling pensions of some definite value.

RECORDING RESULTS OF PROTECTION OF FORESTS FROM FIRE.

It is now more than two years since the Government of India published the Tables illustrating progress in Fire Protection, prepared by Mr. Whittall, then Assistant Inspector General. In the end of the third paragraph of letter No. 94 of 19th February, 1886, the Inspector General in forwarding these Tables for the Central Provinces, remarks on the method by which the figures in the "Accepted" columns have been arrived at. "There are many and serious objections to it, and it is only adopted tentatively, in the hope that some one will arrive at a method of more accurately gauging the real benefit done to a forest by continuously successful fire protection."

As yet apparently no one has made any suggestions which have

been considered sufficiently practical to be accepted, and as I feel sure the subject has not been neglected by my brother officers, I put forward propositions for a different system of calculating the areas in the "Accepted" column with much diffidence.

In the same paragraph the Inspector General says—"It is hopeless to allow credit for areas protected for many years and then burnt"; and then again: "it is much the best to reject altogether than to attempt to allow credit." Now herein I, with all due deference, disagree from our chief. It must be remembered that year by year makes us more acquainted with the conditions of our forests, and thus we progress, slowly it is true, but still progress towards a knowledge of the damage done by fires. And I think that in the case of a fire, credit might be allowed to a fairly accurate amount if the state of things in a block is known. I would base the amount of credit to be given on the age of the oldest trees destroyed by the fire. The credit would of course vary with each block, and there would have to be some record kept of the number of years' protection to be struck entirely out in each block. I admit that this method is arbitrary and not quite exact, but why I recommend it is that it is better than excluding all areas burnt from the benefits of protection from the very beginning. This latter system *we know* is wrong. For instance, a fire occurred in the Garhakota block in 1883-84, spreading over 127 acres, the reserve having been protected (with the exception of a fire of 5 acres in 1881-82) since 1874-75. It stands to reason that the good done by keeping out fire for nine years cannot be swept away by a fire in the tenth. I therefore maintain that any system by which some effort is made to gauge the benefit derived from protection is better than the admittedly bad one of wiping everything out on occurrence of a fire.

I give the following details to illustrate my proposed method. In my division I have two blocks, Taroba and Bhimaram, the conditions of which as regards soil, vegetation, topography, in fact everything, are as different as they can well be. The former is situated on a block of stony hills with extremely poor soil. The dominant species is bamboo, and the tree growth poor both in quality and species. There is much very high grass, and the amount of combustible matter, such as dry grass, dead bamboos, fallen trees, &c., is very great. A fire in this block means terrible damage done to the standing stock, as we have very painfully experienced. Last year a fire ravaged the greater part of the tract, and the sight of the raging flames, the burning clumps of bamboos, the dead trees throwing up columns of fire was quite enough to convince

one that here at any rate most of the good done by previous protection was being made of no account, and that seedlings, which had sprung up under the care of successful protection, must have been destroyed, entirely or partially, up to a comparatively advanced age. Bhimaram, however, presents entirely different features. Better soil, climate more adapted to rich growth, and perhaps more complete success in protection, has resulted in a tree growth so dense as to have killed off the grass in the greater part of the block. Here if such an untoward calamity as a fire were to occur, I do not think it would do much damage, and in parts I doubt whether a two year old seedling would feel the effect of the flames.

I would, therefore, in fixing the number of year's protection to be struck off in case of a fire, put it very high in Taroba and very low in Bhimaram. The method would be arbitrary, I admit, but it would be nearer the truth than the present one. Presumably every Divisional officer inspects the site of a fire as soon after its occurrence as possible, and he could by experiment and close examination come to a fair idea of up to what age the standing growth had been really damaged, and this might be taken as the number of years for which all benefits from protection should be struck out.

Possibly—nay certainly—this period would have to be changed as successful protection fills up gaps, reduces the amount of grass, and generally renders the forest liable to less damage through fire. This of course could be done as necessity arose, and in all cases where the number of years had been fixed a long time previous, the amount of damage to be recorded would only be decided on after a careful examination of the forest.

This gauging of the benefit from fire protection and damage by fire is a subject of great importance, and even if my letter only results in obtaining the opinions of other officers, and my suggestions are put aside as impracticable, good will have been done.

CHANDA, C. P., G. H. FOSTER.
3rd July, 1888.

COMPOUNDING FOREST OFFENCES.

I HASTEN to reply to "Single S.'s" letter on the above subject in the order as it is written.

To answer his first question. My division contains 3,463 square miles of Government forest alone, and I have to maintain a certain amount of supervision over private forests of an equal, if not greater, area. I find that a straight line drawn from the north-

west corner of my district to that in the south-east is 216 miles long. No—the Ranger is not empowered to hold enquiry into Forest offences under Section 71 of the Forest Act. Divisional officers *ex-officio* hold all powers under this Section. But I fail to see the illegality of my action. The enquiry held by the Ranger has no status in a court of law. It is merely to enable the Divisional officer to judge of the truth or otherwise of the statement of the official originally reporting the offence.

To secure as far as possible an accurate and trustworthy report, I take the precaution of having the enquiry made before respectable outsiders. It is in no sense an enquiry under Section 71 (*d*). Again, why is my method "not Section 67?" In that Section there is no provision that before the duly empowered Forest officer accepts composition he should make an enquiry under Section 71 (*d*). I am satisfied that an offence as reported to me has taken place. I therefore offer the accused the alternative of compounding. To do so is entirely optional on his part. What is there in the Act to prevent me, on receiving a report of a forest offence, there and then to offer to the accused the alternative of compounding or standing a prosecution? There is nothing in the Act by which an enquiry by a Forest officer is necessary before demanding composition under Section 67, nor is such provision required, for the framers of the Act evidently credited the public with sufficient common sense to refuse to pay composition when not guilty of the offence it may be charged with.

Reference to pages 156 and 298, Vol. VIII. (not Vol. VII.) does not show me any remark on Mr. Baden-Powell's part to the effect that only those cases which come under the Forest officer's own cognizance should be treated under Section 67.

On the contrary (page 299, first line) he distinctly says—"It was *never* intended that in *every* forest case, the Forest officer should make an investigation, though every higher grade officer may reasonably have the *power to do so*." (The italics are his not mine). In these petty cases occurring from 50 to 100 miles from head-quarters, of which, in my division in 1887-88, despite a staff so numerically weak as to be unable to properly guard their forests, 1,819 were reported to me, it would be utterly impossible for the Divisional officer to hold a regular enquiry under Section 71 (*d*) in every instance. But where is the illegality in my deciding them without having done so? Most of these offences consisted of the taking out from Class B reserves of one or more cart-loads or other loads of produce without a license. To have dragged the people concerned from one end of the district to an-

other would have been cruel to the witnesses, and destructive to the efficient guard of our forests from the absence of the staff engaged in the case, and on the same grounds it would have been almost if not quite as inconvenient, to have sent every case to a Magistrate. I of course hope that your readers do not imagine from remarks made by me, with regard to there being no *necessity* of enquiry before demanding composition, that I never adopt such procedure. I simply wish to answer "Single S." It seems to me that Section 67 is much misunderstood, and Forest officers do not completely take in that payment of composition is purely optional on the part of the accused, and that he can always, by refusing to pay, force the Forest officer either to bring the case into a court of law, or throw it up altogether.

GORARH.

THE NALA PANI SPRINGS, DEHRA DUN.

I THINK it incumbent on me to ask you in your next issue to point out that the surface drainage of the Gurkha encampment, termed "cholera camp" by your contributor "A. C." in his article regarding the water supply from the Nala Pani spring, does not tend towards the 'catchment basin' of that spring.

The camp was not a "cholera camp" in the usual acceptation of the term, but simply an encampment located to accommodate the married Gurkha Soldiers of the 1st Battalion of our local Corps, and thus remove them from the precincts of cholera-infected quarters—*not a single case of sickness af any kind whatever occurred amongst those located in the cholera camp during its existence on the site alluded to.*

I may also mention that the scheme for bringing in the water referred to, in exactly the same manner as is now being carried out by the Municipality, but at a much higher and therefore better level, *viz.*, to a point near the Church on the Rajpur road, above the *Dilaram* Bazaar, was brought forward in 1875 by Mr. W. Holmes, C.S., then Assistant Superintendent of the Dún, but fell through for want of higher official support.

Samples of the Nala Pani water were at that time sent by me to Dr. MacNamara, Government Analyst, Calcutta, for report and examination, and he then declared that it was "one of the purest natural waters he ever analysed." Dehra has, therefore, *at last* something to be proud of in now possessing, limited although the supply be, drinking water of a quality unsurpassed by any in India.

DEHRA DUN,
14th July, 1883.

G. G. MACLAREN, M.D.,
Civil Surgeon.

LOWER CALIFORNIA.

It may interest those of your readers who have read in a recent number of your valuable magazine for May 1888, that the white pine is gradually disappearing from the forests of the United States, to know that a large belt of wood, composed principally of yellow and white pine, has been recently discovered in the centre of Lower California. This belt is from 60 to 75 miles in length, and from 15 to 25 miles in breadth, and covers an area of nearly one million acres, one-half of which is covered with well grown pine.

Two trees that had recently fallen were measured by the explorer, and gave the following results :—

No. 1. 180 feet long, 8 feet in diameter at the butt, 50 feet to the first limb, where it was 5½ feet in diameter.

No. 2. 201 feet in length, 8 feet 2 inches in diameter at the butt, 65 feet to the first limb, where it was 5 feet in diameter.

Fifty-four acres were measured as an average of the region for growing timber, and it was found that 24 large and 8 small trees formed the usual crop.

The upper portion of this pine belt will soon be traversed by a railway, and a large river, which is filled by five branches, flows through the lower end to the coast. It is to be hoped that the proprietors of this valuable forest, will not permit it to be given over without supervision to the ruthless axe of the lumberer. The rainfall of the summer of 1887 was found to amount to 30¼ inches, but if this falls on a hill denuded of its natural covering, its value to the valleys of the plain will be greatly lessened.

St. Andrews, N.B. GEORGE CADELL.

JJ. Reviews.

THE BOTANY OF THE AFGHAN DELIMITATION COMMISSION.*

The recently published report by Dr. Aitchison on the botany of the expedition to Northern Afghanistan during the years 1884-85 is full of interest, not alone on account of the scientific value of the collections, but also as containing a great deal of information regarding the economic value of many of the species, and the uses to which they are put by the inhabitants.

In his introduction Dr. Aitchison gives a graphic description of the different portions of the route taken by the Mission, the physical features of the country, the habits and resources of the people, together with many interesting notes on the more remarkable plants that were met with.

Starting from the vicinity of Quetta on the 22nd of September, 1884, the Mission travelled by rapid marches in a westerly direction to the Helmund river, and reached Hadj-ali on the 16th of October. The greater part of this journey was through a desert of rocks and sand, and as the season was most unfavourable to a botanist, very few specimens were collected. *Pistacia Terebinthus*, var. *mutica*, was the only indigenous tree of any size to be seen. *Stocksia brahuica*, a large thorny shrub, was occasionally met with, its brilliantly coloured inflated fruit rendering it a conspicuous object. The rest of the vegetation consisted of characteristic desert plants belonging to such genera as *Zygophyllum*, *Periploca*, *Ephedra*, *Tamarix*, *Artemisia* (wormwood), *Astragalus*, *Alhagi* (camel thorn), and *Calligonum* (phog); and where the soil is saline species of various *Chenopodiaceæ* abound. A very characteristic shrub belonging to this family is *Haloxylon Ammodendron*, called Tar-gaz in Beluchistán, in allusion to the vivid green colour of its foliage, and its general resemblance to a tamarisk; camels delight

* The Botany of the Afghan Delimitation Commission. By J. E. T. Aitchison, M.D., C.I.E., F.R.S., F.L.S., Naturalist attached to the Mission. Published in the Transactions of the Linnean Society of London, Vol. III., Part I. (1888).

to browse on the smaller branches, on which they can feed continuously without impairing their health. At Zaru several camels were lost, apparently from the effects of eating the berries of *Lycium barbarum*, a shrub belonging to the deadly nightshade family, but not supposed to be itself poisonous. The grain required for the horses was all sent from Quetta ; and the dry fodder, which consisted of the crushed straw of wheat, barley, and juar, mixed occasionally with various grasses, had been collected at Quetta and at various stages along the line of march. Owing to the abundance of tamarisk and *Artemisia* there was no difficulty in procuring fuel.

Dr. Aitchison mentions with regret the loss of fully 100 species collected in the valley of the Helmund. The cases containing these specimens, on being opened at Kew, clearly showed that they must have lain under water for some considerable time. This loss, as Dr. Aitchison remarks, is a real misfortune, as the district where the specimens were collected had not been previously explored by any European.

The Helmund river, which was at its lowest at the time when the Mission reached Hadj-ali, is here deep and swift at all times, and has worn itself a deep channel similar to the cañons of Western North America. The islands and certain portions of the banks which are annually flooded, are well clothed with forests of poplars (*Populus euphratica*) ; otherwise the valley has an extremely desolate appearance, rendered all the more so by the numerous ruined remains of clay-built habitations, and irrigation works. Amongst the ruins there were evidences to show that the earlier inhabitants of this valley understood the art of manufacturing glazed pottery, as well as glass. Villages become more frequent on ascending the valley. The chief crops observed were—wheat, barley, juar, pulse, tobacco, and water melons. The people about here own immense flocks of sheep and goats ; the wool of the former is exported to Persia, and the hair of the latter is utilized for home purposes. The village orchards, which are enclosed within high walls, contain chiefly mulberries, vines, plums and apricots. The only indigenous tree, besides the poplar already mentioned, is a large species of *Tamarix*, usually occurring solitarily on low mounds, and hence called the "Mound Tamarisk."

At a place called Padda-sultan the Mission were encamped on a piece of low-lying ground, which, much to the delight of the animals, was covered by a luxuriant bed of succulent grasses. The most abundant of these grasses was *Panicum antidotale*, (called ghamur in Northern India,) and associated with it were *Eragrostis*

poœoides, *Heleochloa schœnoides*, and a species of *Æluropus*, which in habit much resembles the *dub* grass. Creeping amongst them, and growing in great luxuriance, were plants of the wild melon; its fruit, not more than an inch-and-a-half in length, has a delicious aroma, and seems to have been much appreciated by the camp followers.

The Helmund terminates in a large lake fringed along its shallow margin with tamarisk bushes and reeds; this vegetation extends for about a mile towards the deeper part of the lake, which was covered with numerous flocks of wild fowl.

After passing Jowain, which consists of a number of villages, and is considered the centre of commerce of those parts, the first wind-mill was met with, an evidence of the windy character of the country, and of which, as Dr. Aitchison observes, the members of the Mission had no need to be reminded. Water-mills are also plentiful in this neighbourhood, and supersede the former wherever water power is available. There are some fine orchards at King, containing trees of apple, quince, apricot, mulberry, and trailing vines. The surrounding fields were irrigated by means of a *karez*, which is an underground artificially made channel, through which water is conveyed by tapping a spring at a higher level. The work is begun by sinking shafts to a certain depth, and the intermediate spaces are afterwards tunnelled out. From the village of Pahir the position of Herat was distinguishable by the deep shadows of its numerous orchards and some buildings with tall minarets. The Mission arrived on the 15th of November at Zindijan, a village in the Hari-rud valley, about 30 miles to the west of Herat. From here down to Kumani-besht, which is about 2,000 feet above the sea level, the valley is bounded on the north and east by the Paropamisus range, and to the south by the Doshakh range. The soil is fertile, and a large extent of ground is under cultivation, so that in the early summer months the valley resembles one vast green meadow. Many rare and interesting plants were discovered in this valley, including the true *asafœtida* plant, and other quaint looking species of *Umbelliferæ*, which, suddenly appearing in the month of May, cover the whole face of the country with the vivid tints of their root foliage, and as suddenly disappear by the end of August. Many other remarkable forms of vegetation are mentioned as occurring in this valley, as well as several which owe their attractiveness to the beauty of their flowers.

Leaving the Hari-rud valley at Khusan, the Mission crossed over the Paropamisus range by the Chasma-sabz Pass, and skirting

the northern slopes of these hills, they traversed the Badghis district in an easterly direction, until they arrived at their winter quarters at Bala-Morghab. The climate of the Badghis district is much colder and more humid than that of the Hari-rud valley; and consequently the vegetation is more permanently verdant. The vegetation of the Badghis district varies much according to the nature of the soil, and the elevation above the sea. The hillocks of loose sand are for a short time tinted an exquisite blue by the flowers of *Gentiana Olivieri;* and later on these same spots are covered with a handsome yellow-flowered larkspur (*Delphinium Zalil*).

In August 1885 Dr. Aitchison visited Mount Do-shakh, a range which forms a portion of the watershed between the Hari-rud and the Harut rivers. These hills are of limestone formation, and are about 4,500 feet in altitude. The most interesting find on this occasion was *Cercis Siliquastrum*, a large leguminous bush. It grows plentifully beside a stream on the northern side of the hills, and was not met with elsewhere.

Two expeditions, by different routes, were made into Khorasan, which is in Persian territory. The botany of the hills near Bezd, which reach an altitude of about 7,000 feet, proved particularly interesting. The village of Bezd lies hidden at the base of the hills, and is well watered by a stream. There are some fine walnut trees and oriental planes here, and all kinds of fruit trees grow in great luxuriance; also a standard variety of the grape vine, the sweet green fruit of which is said to be seedless. The pistachio tree is cultivated here; also *Rhus Coriaria* (sumach), the leaves of which are used in dyeing and tanning. This village was famous at one time for its silk, but the worms becoming diseased the industry ceased; and since then the villagers have turned their attention to the production of opium.

Dr. Aitchison concludes the introductory portion of his report with some general remarks on the flora of North-Western Afghanistán, from which the following extract is taken :—

"The flora of North-Western Afghanistán differs much from the typical flora of Eastern Afghanistán, so graphically described by Hooker and Thomson in their introductory essay to the 'Flora Indica.' On comparison of data, I have been led to the conclusion that this difference is due to climatic conditions. The winter is much more severe and of longer duration at similar altitudes than that experienced in Eastern Afghanistán, the temperature falling several degrees below zero (Fahrenheit), and snow lying for some days at an altitude of 2,000 feet. In spring the persistence of damp and cold is also more prolonged—rain, which

at any moment might be converted into sleet and snow, occurring occasionally as late in the season as the end of May. The highest temperature is in July and August, reaching 105° in the shade; and although the summer is very much shorter than that in the tropical zone, the weather is intensely hot while it lasts, no dew falling under an altitude of 3,500 feet. These extremes of temperature between summer and winter and night and day are much intensified by the absence to the north of any mountain range affording adequate shelter from the continuous blasts of bitterly cold wind in winter and of hot dry air in summer, coming from the north-east and north-west respectively. The mountains not being sufficiently high to retain perpetual snow, the water supply is limited to the rivers Hari-rud and Morghab and to a very few perennial springs.

"With such climatic conditions cultivation, below an altitude of 3,500 feet, is impossible without the aid of irrigation, except under the ameliorating influences of a river; and until the dew-line is gained it is a land totally devoid of trees or even shrubs. But as soon as this point is reached *Pistacia vera*, *Juniperus excelsa*, and *Lonicera nummularifolia* appear as forest-trees, and wheat and barley no longer need irrigation."

Let us now turn our attention to the collections themselves, which, as Dr. Aitchison observes, amount to some 10,000 specimens belonging to upwards of 800 species. The number of new species, nearly 100, is remarkably large, considering the desert character of a large portion of the country traversed. The suddenness with which some tracts of country, absolutely sterile-looking for the greater part of the year, become clothed with a richly coloured but short-lived vegetation, is familiar to all who have travelled much in countries where a scanty rainfall is limited to a short period of the year. Dr. Aitchison, in referring to the first portion of the journey from Quetta to the Helmund, remarks: "The season of the year was against any good collections being made, so that the little I did collect were mere scraps." The present writer was fortunate in being able to visit Quetta and the neighbourhood during a very favourable time of the year, and he was much struck with the luxuriance of the vegetation. Several species which occur plentifully round-about Quetta are not enumerated at all in Dr. Aitchison's list, and for many other species found in Northern Beluchistán there are no records in his list of their existence south of latitude 34°. This of course is no fault of Dr. Aitchison; and, as far as the botany of the Quetta district is concerned, is of little consequence, as a large portion of this country has been carefully explored during several seasons by Mr. Lace, the Deputy Conservator of Forests in Beluchistán. The extensive

collections made by the latter officer will form valuable material for supplementing Dr. Aitchison's investigations.

The 800 species collected by Dr. Aitchison represent 73 natural orders, of which the *Leguminosæ* and *Compositæ* head the list as to the number of species, *viz.*, 78 each; then come the *Gramineæ* with 64 species, *Cruciferæ* 57, *Chenopodiaceæ* 39, *Labiatæ* 34, *Borragineæ* 32, and *Umbelliferæ* 30. The largest genus is *Astragalus*, of which 38 species are enumerated; of these latter 14 are new to science, and the majority of them have been named after members of the Mission.

Of the *Ranunculus* family the most important discovery was that of a new species of larkspur, called *Delphinium Zalil*, after its vernacular name. Its handsome golden-coloured flowers are collected largely for exportation, chiefly to Persia, for dyeing silk. It is a common plant in the Badghis district, where it forms a great portion of the herbage.

The common barberry is common above 3,000 feet, and the fruit is sold in the markets.

Poppies are plentiful, and when in flower give a brilliant colouring to the landscape. *Papaver pavoninum* and *Rœmeria rhœadiflora* are particularly handsome kinds. The opium poppy is cultivated on a small scale in the Hari-rud valley, and largely in Khorasan.

Cruciferæ are very abundant; the majority of them are small herbaceous plants; and, though contributing largely to the verdure and colouring of the short-lived spring vegetation, are of little consequence. Some few, however, are of great value as food. The turnip, for instance, is very largely grown throughout Afghanistán and Persia; the cabbage is also mentioned as being successfully grown in the Hari-rud valley. *Eruca sativa*, called *Túramira* in Northern India, is largely cultivated for oil, also a variety of *Brassica campestris*, called *shersham* (the *sarson*, probably, of Northern India); the latter, however, has only of late years been cultivated to any extent. A kind of Sea-Kale (*Crambe cordifolia*) is common in the Badghis district; its turnip-like root-stocks are collected by the Turcomans, and stored as winter food for their camels.

The caper plant, Dr. Aitchison says, is one of the few shrubs which extends from Northern Beluchistán to Bala-Morghab and Khorasan. The natives eat the fruit, and camels browse on the branches.

The underground stems of two species of *Caryophyllaceæ*, *viz.*, *Acanthophyllum macrodon* and *Gypsophila paniculata*, are collected and employed instead of soap for washing clothes and wool, &c.

No less than seven kinds of tamarisk are recorded; two of these, *viz.*, *Tamarix gallica* and *T. articulata* are common in Northern India; a variety of the former yields a manna, which is known at Kerman, in Persia, under the name of *Gaz-shakar*.

Cotton is cultivated throughout Afghanistán and Persia; the staple, however, is inferior.

There are forests of the pistachio tree (*Pistacia vera*) in certain parts of the Badghis district, occurring in such abundance in one place as to give it the name of Pistalik. It is from these forests, Dr. Aitchison ascertained, whence the bulk of the nuts come which find their way into India. Another species of *Pistacia*, (*P. Terebinthus*, var. *mutica*), is widely spread throughout the hilly portions of Beluchistán, Afghanistán, and Persia; the seeds are eaten or crushed for oil; it yields excellent firewood, and on this account it is too rapidly disappearing from localities where fuel is much in demand. The *sumach* or *samahk* (*Rhus Coriaria*) is cultivated in Khorasan in orchards. The leaves yield a valuable tanning material, and from the bark a dye is obtained.

Leguminosæ are largely represented, and include a great number of useful species, several of which are extremely handsome and worthy of cultivation. Nearly half of those recorded by Dr. Aitchison belong to the genus *Astragalus*. They are mostly thorny shrubs, either erect or prostrate, whilst a few are spineless herbs. The shrubby kinds are invaluable for fuel, and nearly all of them afford excellent fodder for sheep, goats, and camels, and even horses. The long cord-like roots of some of the species are used by the shepherds in the place of rope or twine. The inflated pods of *A. gompholobium* are called "grapes" and "melons" by the natives, who eat them for the sake of the liquid they contain. *A. heratensis* resembles a miniature oak in habit; its main stem is smooth and spineless, and from the bark a gum, called *katira*, is collected and exported as an article of commerce. Lucerne was found apparently wild in the Badghis district; it is also cultivated, and is used chiefly for horses. Fenugreek, and a kind of clover (*Trifolium resupinatum*) are cultivated for fodder. Gram (native name *nakhud*), and the common lentil are grown in Khorasan.

Another important family is that of the *Rosaceæ*, and Dr. Aitchison has some interesting notes regarding them. Fourteen species of *Prunus* are recorded, including the apricot, the almond, and the peach, all of them cultivated; the peach is always grafted and bears fine fruit. *Prunus divaricata* is cultivated in orchards, and yields a small fruit like a plum. The fruit of *P. calycosus*, a new species, is called *siah-ling*, and is said to be

of the size of a cherry; from the bark of the root a dye is obtained, which gives a dark red or maroon colour. Another species of *Prunus* (unnamed) is cultivated for its fruit, which is black and larger than that of an ordinary cherry, but not very palatable. Other fruit trees observed by Dr. Aitchison, and belonging to the same family, were—the quince, the fruit of which from grafted trees is usually very large and of fine quality; and the common pear, which occurs both wild and cultivated. The grafted pear trees bear a large fruit called *nak*, which is exported to India in large quantities. The small fruit of the wild kind is dried, ground, and mixed with wheat flour to increase the bulk. Mulberries and the fruit of *Celtis caucasica* are prepared in a similar manner. The apple, native name *seb*, is largely grown in orchards, but is said not to be grafted. A kind of wild apple, with a small but edible fruit, is reported to be common on the hills around Kushk and above Bala-Morghab. Several kinds of roses are enumerated, including *Rosa damascena*, from which rose water is prepared, the single yellow Persian rose, and the common climbing rose of India (*R. moschata*); all these three are cultivated. The kind most commonly met with westward of Bala-Morghab and into Khorasan is *R. berberifolia*, the foliage of which is peculiar, the leaves being single-bladed like those of the barberry; the flowers are bright yellow, and with a purple spot at the base of each petal.

To the cucumber family belong the water melon, and the ordinary melon, together with its far-famed variety known as the *Sarda* melon. Dr. Aitchison considers that in Afghanistán water melons rank next in value to wheat as a food crop, for during two or three months of the hot weather the natives seem to live entirely upon them and a little bread. He also remarks that the fruit, as a rule, is very much sweeter than that grown in India.

Dr. Aitchison was fortunate in being able to secure fine specimens of several of those large strong-scented umbellifers, which are so characteristic of the Central Asian flora. Of these the most important from a commercial point of view is *Ferula fœtida*, which yields the well-known drug called *asafœtida*. Every part of the plant, in all stages of its growth, exudes upon abrasion a milky juice, which when dried constitutes the *asafœtida* of commerce. Its flowering stem before emerging from the inflated leaf-sheath resembles a cabbage; and afterwards, when the flowers are exposed, the inflorescence is not unlike a cauliflower. *Ferula galbaniflua*, from which a gum called *galbanum* is obtained, is found on both sides of the Paropamisus range, and often in such abundance that no other vegetation is visible over large stretches of

country. The gum is usually found at the base of the stem. *Ferula suaveolens*, a newly described species, was discovered in Khorasan; its scented root is supposed to be one of the kinds of *sumbul* exported from Persia to Bombay. *Dorema Ammoniacum* is abundant in the Hari-rud valley; it has large root leaves like those of the *asafœtida* plant. As soon as the fruit begins to ripen the plant is attacked by some boring insect, causing the flow of the milky juice, which dries into hard lumps, often enclosing the fruit. Another species of *Dorema* (*D. glabrum*) was found in the bed of dried-up watercourses. This plant grows to an enormous size, and has an immense panicle of brilliant yellow flowers like those of the *babul*. *Ferula oopoda* is one of the most remarkable of the plants that were collected on this expedition; the stems, which are upwards of 6 feet in height, bear at intervals enormous bowl-like stipules. A story is related by the Turcomans regarding a fugitive, who, almost dying from thirst, got a life-saving drink from one of these cups, from the dew collected therein. Several were examined by Dr. Aitchison, but not a drop of fluid was found in any of them. *Ferula ovina* affords excellent grazing for all animals, and is considered to be very fattening for horses. The carrot is largely cultivated both in Afghanistán and Persia. Of the 48 plates accompanying this report, no less than 19 represent specimens of this interesting family.

The *Compositæ*, though one of the largest of the families represented in Dr. Aitchison's collections, do not contain very many plants of economic value. Some of the artemisias (wormwood) constitute the chief camel fodder of the arid tracts, and are also much valued as fuel. *Gundelia Tournefortii* is collected in the autumn and stored as hay for cattle fodder. Safflower is cultivated in Afghanistán and Persia for its dye. Several of the species have handsome showy flowers, *e.g.*, *Achillea micrantha*, *Tanacetum umbelliferum*, *Onopordon leptolepis*, *Jurinea monocephala*, *Centaurea plumosa*, and many of the species of *Cousinia*, of which no less than 17 are enumerated.

Two kinds of ash were met with; the wood is in much demand for all domestic purposes.

Apocynum venetum, which occurs plentifully in the Badghis district, is recommended to notice on account of its fibre; its annual stems measuring about 4 feet, remain attached to the creeping root-stock long after they have flowered and ripened fruit; by the action of the wind they are soon reduced to shreds of fibre, appearing as though they had been artificially prepared. It is used by the natives in the manufacture of cloth.

Tobacco is largely cultivated in Afghanistán and Khorasan; whether it is exported to any extent could not be ascertained.

Of the *Orobanche* or *Broom-rape* family, two new species are described and figured; one of these, named after Sir West Ridgeway, is a handsome plant upwards of 2 feet in height; it is parasitical on the roots of a tamarisk.* *Orobanche Stocksii* is used for camel fodder, and the stems of another species are eaten as a vegetable.

Til (*Sesamum indicum*) is cultivated for its oil; it is usually grown in the same fields with water melons.

The *Chenopodiaceæ* are largely represented, several of the species being highly characteristic of the arid and saline tracts of Central Asia, where they afford an abundant supply of food for camels. The spinach plant, also called *spinaj* by the natives, is abundant in the Badghis district, and is used as a pot-herb. From *Salsola fœtida* and *Anabasis eriopoda* a coarse *barilla* is obtained by burning. A curious prickly fruited plant, called *Agriophyllum latifolium*, is found on the sand hills of the Beluchistán desert; notwithstanding its long roots, the wind, owing to its abundant foliage, lifts it out of the sand, whence it may be seen rolling in collected masses all over the flat clayey plains. A species of *Haloxylon* (*H. Ammodendron*) attains the size of a small tree. It occurs locally from Northern Beluchistán to Khorasan. The trunk of one specimen measured by Dr. Aitchison was 12 feet in circumference, the whole tree not exceeding 14 feet in height.

The most noteworthy of the *Polygonaceæ* is *Rheum tataricum*, a kind of rhubarb; it is plentiful in the Hari-rud valley, where the fruit and roots are used as a purgative. The root of *Rheum Ribes* is used for colouring leather, and the branches of the inflorescence are collected and eaten raw by the natives. *Calligonum comosum* yields good fuel, and the young shoots are eaten greedily by camels. An allied species, also called *phog*, is plentiful in the drier parts of the Punjab, and is also a favourite food of camels.

Thirteen species of *Euphorbia* are enumerated. The castor-oil plant is cultivated in the Hari-rud valley and in Khorasan, the oil being used for burning; its purgative properties do not appear to be known to the natives of those regions.

Two kinds of elm are cultivated, the common one, *Ulmus campestris*, and *U. montana*; the wood of both is much valued. Mulberries are much cultivated in orchards for feeding silk worms, as

* The same, or a closely allied species, has lately been collected by Mr. J. H. Lace in the neighbourhood of Quetta.

well as for the fruit. The common fig is also extensively cultivated in Afghanistán and in Persia. Both male and female plants appear to be indigenous in the Badghis district, and in Eastern Persia. Dr. Aitchison adds an interesting note on the various forms of the floral receptacle, the shape varying according to whether they contain male flowers female flowers or gall flowers, the latter being really female, but sterilized by the action of the gall insect.

The oriental plane (*Platanus orientalis*) is cultivated in villages in Afghanistán and Persia; the wood is largely used, especially for the construction of the village gates.

The walnut is largely cultivated, and the fruit is exported to India.

Willows, both wild and cultivated, are abundant wherever water is to be found. Of the two poplars recorded, *Populus euphratica* is a common river-side tree, and in many localities forms forests; its timber is generally used as fuel, and the foliage affords excellent fodder for camels.

The *Gnetaceæ*, a family allied to the conifers, is represented by seven species of *Ephedra*, peculiar shrubby plants with articulated branches and the foliage reduced to scales; the fruit is often succulent and edible. The Afghan names for some of the species are *hum* and *huma*;* this circumstance, together with other facts, has led Dr. Watt to the opinion that the *soma* plant of the ancient inhabitants may possibly be referred to one or more of the *Ephedras*. Experiments are about to be made in order to ascertain whether these plants contain any special substance capable of acting as a ferment.

Juniperus excelsa is the only indigenous conifer of these parts. It is a large tree, and forms extensive forests above 4,500 feet. *Pinus halepensis*, a Mediterranean tree, is often planted round gardens and orchards to break the force of the wind, and is frequently to be seen in the neighbourhood of shrines.

The tubers of two species of *Orchis* (*O. latifolia* and *O. laxiflora*), known as *salap* or *salab*, are collected for export to India.

The Iris and Lily families are represented by several very handsome flowering species belonging to the genera *Iris*, *Crocus*, *Eremurus*, *Allium*, *Fritillaria* and *Tulipa*. A curious jelly-like substance is obtained by boiling the fleshy roots and leaves of *Eremurus Aucherianus*; it is used in the manufacture of vessels, called *dabba*, for holding oil and clarified butter. In Khorasan

* *Periploca aphylla* is known to the Afghans under the same names.

there is a considerable trade in this material, and Dr. Aitchison is of opinion that its introduction into India would be appreciated by the Hindu community, by its taking the place of the receptacles made of animal skins which are now employed so much in the oil and ghi trade.

The cultivated cereals are wheat, barley, china, bájra, and juar. The wheat is generally of inferior quality. The 6-rowed barley is the kind usually grown for its grain; it takes four months to ripen. China (*Panicum miliaceum*) is grown in the Badghis district. Bájra and juar are very sparingly cultivated. The following are the more valuable fodder grasses:—*Pennisetum dichotomum*, which grows luxuriantly amongst rocks in the desert tracts; its stems are often as much as 3-4 feet high; and, though resembling miniature bamboos, were greedily eaten by the horses belonging to the Mission. *Aristida plumosa* constitutes the chief fodder for sheep in the sandy portions of the desert. *Poa bulbosa* grows plentifully and in great luxuriance in the Hari-rud valley, as well as in the Badghis district, and is much valued as fodder. *Agropyrum Aucheri* and *A. cristatum* are also much used, and being late grasses, they come in usefully as a second crop. Ordinary barley is cultivated in the Hari-rud valley as fodder for horses. Other kinds considered by the natives as yielding good fodder are:—*Panicum antidotale*, *Polypogon littorale*, *Phragmites communis*, and *Eragrostis cynosuroides*, the latter, known as *dáb* in Northern India, was met with in great abundance in some localities. *Dub* (*Cynodon Dactylon*) is rarely to be seen in Afghanistán, though abundant at Quetta along the sides of irrigation channels.

The only fern met within Northern Afghanistán was *Adiantum Capillus-Veneris*; *Cheilanthes Szovitzii* was gathered in one locality in Khorasan.

Accompanying this report are two useful maps, and 48 excellent plates illustrating some of the more interesting species.

Altogether the botanical results of this expedition must be considered as highly satisfactory. To have collected upwards of 10,000 specimens, which, owing to the nature of the climate, must have been procured within a comparatively brief space of time, indicates an amount of honest physical industry, which few can appreciate who have not had some experience of the work of a collector marching continuously nearly every day.

FORESTRY IN THE ANDAMANS.*

MR. Carter's report on forestry in the Andamans is said in the Government of India orders to be the first clearly written one received, enabling Government to follow the operations of the Department.

As the Forest Act has not yet been extended to these islands, strictly speaking there are no forest reserves, but practically the whole area not actually cleared is reserved, and the forests are naturally protected from fires and grazing, whilst the habits of the aborigines, and the control exercised over the convicts, prevent forest offences.

The chief attention of the Forest officer is therefore directed to profitable exploitation, chiefly of padouk (*Pterocarpus indica*), and to the reproduction of this species in the forests.

Mr. Carter's remarks on this point deserve reproduction, and are as follows :—

"All efforts to encourage natural reproduction would naturally be directed towards padouk, the most valuable species in the forest; little experience has as yet been gained, and what is known offers little encouragement. The padouk trees in the forest are of large size and great age, so that not less than one-half are hollow and useless. There is no gradation of age-classes, so far as padouk is concerned. The existing trees are probably 300 years old, and for the past three centuries no natural reproduction of padouk has taken place. Other species have taken possession of the blanks which have been caused by fallen trees. These species must have been for the greater part shade-enduring trees previously existing in the undergrowth, and to a less extent seedlings of species with very rapid growth, which were able to get their crowns through the advance growth before it formed a canopy. Only in this way can the prevalence of such shade-avoiding trees as *Bombax* and *Payanelia* be accounted for. The shade-enduring advance growth has in many cases been *Diospyros* and *Murraya exotica*. The system of selection-felling, without special operations to encourage a desired species, must result in a forest consisting of trees capable of enduring dense shade, interspersed with trees (not necessarily shade-enduring) of very rapid growth. To neither of these classes does padouk belong. It cannot endure a dense shade, or it would be found among the undergrowth in the forest. The shade given by it is not dense, for in the young plantation of padouk, although its canopy is complete, the ground

* Report of Forest Administration in the Andamans for 1886 87, by P. J. Carter, Deputy Conservator of Forests, with the usual Government orders.

is covered with a growth of low grass. It is true that this grass is of a shade-enduring kind, but it is entirely absent from the adjacent plantation, in which teak is the principal species. Nor is padouk of rapid growth when very young. When five years old it is scarcely more than half the height of a teak tree of the same age, although it is very probable that at the age of ten years and afterwards its growth would rival that of teak. The natural reproduction of padouk, therefore, must entail a considerable expenditure in clearing the ground to enable the seedlings to establish themselves, and in weeding out other species until the young padouk is out of danger, probably until the age of ten years."

We read further on in the report that the teak planted in 1883 at Goplakabang are as vigorous as any plantation in Burma, and the mixture with padouk will be favourable. Mr. Carter considers this plantation as the beau-ideal of what a teak plantation should be, and that there is probably nothing finer of its kind in India. Older teak plantations at Port Blair have not proved successful, but the plants were too far apart, sometimes at distances of 30 feet, and cattle were tethered under the trees, which, growing without any undergrowth, have naturally not developed straight boles.

There can be no doubt, as is remarked in the Government review, that teak forests in the Andamans would probably be the most valuable in the world, on account of the facility of transport, and we are glad to hear that extensions of these plantations are to be pushed on vigorously, and also that valuable species of bamboos, as *Dendrocalamus Brandisii*, are being introduced.

During the year girdling was stopped, as there was a large balance of girdled trees in the forest. 4,158 trees, yielding 7,173 logs, were felled, about one-third of which were padouk. 5,076 logs were delivered at forest depôts, 3,375 to sale depôts, at which the following were the principal transactions :—

"Two thousand three hundred and eighty telegraph posts sold for Rs. 13,265-11-5, after deducting shipping charges and commission, being Rs. 5-9-0 per post, and Rs. 75-14-6 per ton. On those delivered by contractors at Rs. 3 per post, the net profit was Rs. 2-9-0 per post, or Rs. 38-6-6 per ton. Twenty-five were lost in shipping, and 100 rejections are lying in Calcutta, which will further reduce the net profit.

"Sixty-one padouk squares sold in London, Hamburg, and Havre, the London price being £10 per ton; and after deducting charges, the net rate was Rs. 56-12-4 per ton.

"Six hundred and one padouk planks sold in London for £10 per ton, yielding, after deduction of charges, Rs. 72-10-6 per ton. These

were delivered by contractors at Rs. 25 per ton, and the net profit was therefore Rs. 47-10-6 per ton.

"Three thousand four hundred and forty-one tea-boxes sold for Rs. 2,264-3-3, or Rs. 43-14-0 per ton. These were of Toungbeing, Thitmin, and Simal."

Mr. Carter has calculated that the cost of timber delivered at Port Blair is Rs. 14-2 per ton, and at Shoal Bay Rs. 22-4 per ton.

From the latter depôt, timber has to be shipped to Europe, and we read as follows regarding the proposed shipments to London of padouk timber:—

"Although it had been urged that a ship carrying 600 to 700 tons of coal should be sent from England under contract to take a cargo of timber back, a ship carrying 1,700 tons of coal was sent without any arrangement as to the timber. Only 670 tons of timber were ready to be loaded, and the master of the ship refused to take these on reasonable terms. No ship suitable to carry the timber could be obtained in Calcutta, and the agents are now arranging for a ship at home at a freight of £2 per ton. Another year will therefore elapse before it can be ascertained whether any considerable trade can be done in padouk timber from the Andamans."

Mr. Carter's remarks regarding elephants will be useful where these animals are used for dragging—

"The number of elephants at the commencement of the year was 27 in addition to one calf, and at its close 20 and one calf. Seven elephants died during the year. In December the custom of giving grain rations to the elephants was resumed. For elephants working every day, unless they are sick, grain rations are a necessity and not a luxury. The outturn of timber is entirely dependent on the number of elephants available for dragging. The number now on hand are only just sufficient to drag the logs needed for local consumption; and even to do this, they are over-worked. If therefore it is found that an export trade in padouk can be done on a larger scale, more capital must be invested in elephants, or in a portable tramway. The latter is probably more advisable, for casualties among the elephants have been numerous during the past two years, and they are here peculiarly liable to a disease of the feet. Two of the present elephants have been thus incapacitated for work for six months, and it seems even doubtful if they will recover."

The surplus of the year's transactions was Rs. 5,580, besides a valuable cargo of timber being stored at Shoal Bay, and a surplus of Rs. 7,300 for timber works by District officers.

Surely it might be found practicable to have one account for all the timber works in the Andamans.

THE FORESTS OF TASMANIA.*

We congratulate Mr. Perrin on having recognized the proper basis for a system of National Forestry in any country, namely, that large areas of forest land must be set aside, and the attention of a State Forest Department concentrated on the proper management of these areas, instead of spreading operations over a wide, and in most cases unprofitable, area of country.

This doctrine, though apparently so simple, is not yet admitted in North America, where Dr. Mayr, the Bavarian Forest officer who has recently been appointed Professor of Forestry at the Agricultural College of Japan, at Tokio, has recently been travelling, and asserts that, 'although forestry everywhere begins with destruction, yet in North America, this destruction is unprecedented, and will render future forestry almost impossible should the destruction of trees and soil by fire and clearing be carried on for a few more decades.'

Our Australian Colonists have proved wiser in this respect, and Mr. Perrin states that South Australia has gone ahead of the other colonies, in laying out large State reserves to supply a continuous quantity of first class timber, and fuel, and for climatic and local protection of hilly ground.

Mr. Perrin recommends that the example of South Australia should be followed in Tasmania, which, being an island, possesses great facilities for exploitation of forest products, and we shall be glad to hear that his recommendations have been accepted by the Government. We do not agree with Mr. Perrin in advocating plantations of exotic trees to yield timber superior to indigenous kinds. This class of forest operation generally involves great expense, and much uncertainty of result, but is apparently always the first idea of new Forest Departments.

The cultivation of the following indigenous species is advocated :—

Huon pine, King William pine (*Arthrotaxis selaginoides*), Celery top pine, Oyster Bay pine, the scientific names are not given. It appears that the high table land of Central Tasmania at 2,000 feet above sea level comprises a large area comparatively treeless, and exposed to the cold westerly hurricanes and icy winds from the snow-clad mountains. In this tract, agriculture has made no headway, and tree planting is suggested to give shelter to the

* Annual Report on the Woods and Forests of Tasmania, 1886-87, by G. S. Perrin, F.L S., Conservator of Forests.

flocks. On the mountain slopes are dense forests of Tasmania, beech (*Fagus Gunnii*) and *Fagus Cunninghami*.

Mr. Perrin urges the necessity of timber royalties to find the wherewithal to run his Department, and also that no trees should be felled in the State forests unless previously marked by the Forest officer.

Another urgent matter is the selection of reserves near the mines, where scarcity of timber and fuel soon becomes felt.

Mr. Perrin gives examples of the necessity for such reserves, which we quote—

"To persons familiar with the great diggings of Victoria—Ballarat, Sandhurst, Castlemaine, Clunes, Maryborough, and hosts of other familiar places—they will remember the frightful desolation wrought among the fine forests which once surrounded those places.

"In 1851 Bullarook Forest—one of the best timbered regions of the Colonies—stood in its virgin prime, and possessed, it was *then* thought, timber sufficient to supply all the gold mines in the world. Twenty years later, what was its condition? The bulk of it selected, the rest hacked, burnt, and partially destroyed by the very people who required it most—the digger and splitter—both dependent upon the mines for their livelihood. At the present time companies have now to pay heavy freight charges on timber brought from great distances, in the place of that near to hand so recklessly destroyed in years gone by. For years this great forest stood a standing reproach to the Government of Victoria, who, however, have at length awakened to their responsibilities and proclaimed reserves, and thus atoned for the errors of the past. Twenty-five years ago a fine forest existed just outside Clunes, and extended for miles in the direction of Majorca. That has disappeared, and eighteen years ago when I passed through that country, I saw millions of fine saplings, forming dense young forests for miles. Had that timber been conserved *then*, Clunes would this day be well supplied with timber worth thousands of pounds to the mining community, instead of, as is now the case, paying heavy rates on all they use, whether for domestic or mining purposes, when the money thus spent would go to swell dividends or keep mines going (until, perhaps, deeper 'leads' were struck) a little longer to the benefit of miner and tradesman alike. These are facts which appeal to the mining community at large. In Tasmania we have few permanent 'fields,' but there are several which are likely to become such, and chief of these is Beaconsfield."

Mr. Perrin gives a diary of his travels with some interesting notes, and as he has been over nearly 4,000 miles, and one-fourth of the distance on foot, during the year, we must congratulate the Tasmanians on having secured such an active Conservator, and

hope that the Government will ere long organize forest management on a scale commensurate with the future requirements of the colony.

That forestry is not at present properly appreciated in Tasmania the following paragraph of the report clearly proves :—

"*Office Accommodation.*—In this matter I feel I have just cause for complaint, as at present I am a veritable 'Ishmael' of the Lands Office. The room allotted to me having been 'jumped' by the Mining Department, I have no place for papers, letters, &c., whilst a small though valuable private library (works of reference, &c.), and a number of valuable natural history specimens, are slowly but surely being spoiled through the lack of proper accommodation."

REPORT ON CALCUTTA BOTANIC GARDEN, 1887-88.

We have just received the Annual Report of the Calcutta Botanic Garden for 1887-88, which is written by Mr. David Prain, the Officiating Superintendent during Dr. King's absence on privilege leave. Amongst other matters of interest we note the cultivation of *Victoria regia*, the gigantic water-lily which attracted numbers of visitors. The plants died down in the cold weather, but will be replaced by seedlings.

Mr. Prain's remarks about the cultivation of *Pithecolobium Saman* are here reproduced—

"The demand for seeds and plants of the rain-tree (*Pithecolobium Saman*) was very extensive. This tree, a native of America, the history of whose introduction is narrated in the Garden Reports from 1878-81, is already well known in Bengal. Its timber is not valuable, but it grows rapidly, gives excellent shade, and is a useful nurse if planted with slower growing trees, to be cut down when the latter are sufficiently established. The reason for the suddenly increased demand was the statement that the rain-tree will grow on *Usar* soil, and that such soil can thus be reclaimed. *Usar* soil is barren: what is apparently meant is that the tree will grow on soil impregnated with *reh* salts. Such soil is not necessarily unfertile, though without special treatment it may not afford crops except during the rains. The effects of the presence of trees may easily explain the absence of efflorescence of the *reh* salts without much improvement in the nature of the soil, nor would it be surprising to find that after a series of years of rain-tree cultivation analysis of the soil showed little change. But the cultivation of the tree is simple, and must increase the amenity of such districts; while its profuse crop of sweet pulpy pods, which cattle greedily eat, ripening as it

does in April and May, supplies a valuable fodder when usually fodder is most scarce."

The Herbarium has been largely enriched during the year, many rare specimens having been sent by Mr. G. Mann from Assam.

The Lloyd Botanic Garden at Darjiling was under Mr. W. Kennedy during the year, and the chief subject of interest noted is the failure of English seed for potatos, and the spread of potato disease in Sikkim and the Khasia Hills, to combat which, the introduction of seed from Australia and other countries, where conditions of growth differ less widely than in England from those of the Indian hills, is advocated.

The distribution of mahogany and other economic trees and plants continued to the fullest extent of the capabilities of the garden.

The impetus given to roadside planting in Bengal to a large extent accounts for this activity; 67,854 plants having been given out.

JJJ. Notes, Queries and Extracts.

Forests of Tunis.—The following interesting account of the forests of Tunis has recently been issued from the Foreign Office in the form of a Consular report.

The forests of Tunis which cover an appreciable part of the surface of the country were, until the French occupation, subject to no supervision, and suffered from many causes resulting from the want of that supervision. In 1883 the French, alive to the importance of preserving what remained of these forests, which are the property of the State, placed them under the management of a separate department, which has carefully explored their extent and conclusively demonstrated that they are an important element of national wealth.

The explorations of the new department have resulted in the division of the forests into two main groups; one consisting of the cork tree and deciduous oak, locally known as "Zen," covering the north-western angle of Tunis, where it abuts on the Algerian frontier and the sea, inhabited by the Kroumirs, and separated from the rest of Tunis by the river Majerdah. These trees grow in a stratum of sandstone, which again reposes on the upper chalk, and they completely disappear where the latter stratum crops to the surface. They cover an area of about 360,000 acres, on 330,000 of which flourishes the cork tree, and on 30,000 the "Zen." It is found that the former invariably grow on the southern slopes of this mountainous region; and on the northern slopes and in the hollows of valleys the latter.

South of the river Majerdah both these trees disappear, and give place to the pine and a species of evergreen oak. They are scattered over various mountainous regions of no great elevation, all comprised in the northern half of the Regency, where alone the rainfall is sufficient to sustain their growth. The principal forest groups are found in the following places:—Zaghouen, Djuggar, and Jebel-el-Erssaas not far from the city of Tunis; Kessera and the Zlass mountains further south; Sidi Yussef Wady Melegue Nebeur, and Haydra further towards the west. It is calculated that these several forest groups cover a surface about equal to that covered by the cork trees and "Zen," *viz.*, 360,000 acres.

These latter forest groups are in a more neglected state than the former. For the most part they are nearer to important towns than the cork forests, and from time immemorial have supplied those towns with fuel. The bark of the pine is also used for tanning and colouring hides and skins, and as no control is exercised over the cutting down of trees or stripping them of their bark, and goats are allowed to roam everywhere, the forests are rapidly deteriorating. No legislation has as yet been adopted for putting a stop to this waste, and though the Department of Woods and Forests proposes that the Chiefs of the contiguous villages and tribes should be held responsible for the depredations, the Government has not yet ventured on this high-handed measure.

It is to the cork forests that the attention of the new administration has been mainly directed. They are situated in a country with a very sparse population, dwelling in huts formed of the branches of trees. Their number is estimated at 18,000 souls, or only one individual to 30 acres. It was open to the French administration which wields the authority of the Bey to adopt one of the three following systems in dealing with the woods and forests, *viz.*, their sale, their concession for fixed periods, or their management by the State. The last was chosen as the system best adopted for their preservation and extension, particulary as it is held to be of paramount importance to favour the increase of rainfall in the country, the quantity of which is supposed to be intimately connected with the extent of the forests. That they were more extensive in the times of the Romans, and that they conduced to augment the annual rainfall, may be inferred from the discovery of numerous aqueducts among hills, which are now absolutely denuded of trees and destitute of springs.

Much has been done during recent years in improving the condition of these cork forests. Roads have been cut through them, and at stated intervals spacious alleys have been frayed to serve as a means for arresting the march of the destructive fires which frequently ravage them. Above all much progress has been made in barking the cork trees—an operation which consists in stripping the rough bark of the trunks of the trees to the height of 5 or 6 feet from the ground. This virgin bark is without value, and only ten years after the trees have been robbed of it the inner bark is available for commercial purposes, the trees giving a crop of cork every ten years. To meet the expense incurred in these operations, there were available the sums accruing from the sale of the trees already felled, and of the bark of the "Zen" for tanning. Little has been done towards working the less valuable for-

ests to the south of that river. An experiment has been made in planting with trees small tracts of mountain land near Hammam-el-Enf, some ten miles to the east of the town of Tunis. The operation consists in digging holes at short distances, and in dropping in each a few seeds of the pine tree. . Several hundred acres have thus been planted with tolerable success, at an expense of £4 10*s.* an acre..

The worst enemies of the forest are goats. Some French colonists have taken steps to exclude those animals from their estates, and the result has been that shrubs, which never attained the hieght of more than 2 or 3 feet, have in four or five years assumed the dimensions of trees. This is particularly apparent in the large domain of Enfida, near Susa, belonging to the Franco-African Company, where the Thuria, a species of cypress—which covers much of that domain—from a dwarf shrub has now within the space of six years attained a height of 20 to 25 feet. The French Railway Company, which owns the line running from Tunis to Algerian frontier, has succeeded in planting a considerable number of the *Eucalyptus resinifera* (the Red Gum tree) and *Acacia cyanophylla.* It is estimated that 300,000 trees have been planted along the line of railway.

The cost of planting an acre with the eucalyptus amounts to £20, about 1,600 trees going to the acre of nursery ground. After planting out, it is probable that at the end of 20 years 600 trees will have survived, worth 8*s.* a piece.

The bark of the *Acacia cyanophylla* is rich in tannins, and valuable for the tanner. In the whole of Southern Tunis there exists but a single forest formed of a species of acacia. It is situated about 25 miles inland from Ifax, and covers an area five miles long by a little over a mile in width. This forest, which was formerly much more extensive, is protected from the northerly winds by high land, and the trees grow in clumps in depressions of alluvial soil. Though they only attain a height of 10 feet, the trunks furnish planks 8 or 10 inches wide, of an exceedingly hard grain, and capable of taking a fine polish.—J. R. J. in *Gardener's Chronicle.*

The Trout's Precept—and Practice.

If birds can talk, as Æsop, Gay,
With Phædrus, Grimm and others say,
And beasts can signify their wishes
In prose or verse, then why not fishes ?
Horace, 'tis true, has called them "mute" ;
But talk they do beyond dispute.

And if you'll listen to my story
I'll demonstrate the fact before ye.
  Where Thames with silver current flows,
Nor yet with scent salutes the nose,
Or furnishes the missing link
Between "Superior Stout" and Ink,
Snug in a hole beneath a weir
An aged trout had made his lair.
He was the hermit of the reach,
His hoary scales and sapient speech
Combined among the finny nation
To give him wisdom's reputation.
Full many a time and oft they say,
From rod and line he broke away:
While curses loud and deep as thunder
Lit on the piles he darted under.
The deep experience gained by age
Had made him now so trebly sage
That all in vain the lure was spread,
Dace, lobworms, flies, or lumps of bread:
He would'nt even smell a "Pirate."
(I hope G. K. will not be irate).
In vain the angler searched his book,
He "slung," but would'nt take, "his hook."
  Feeling at last the end was near,
When water should become his bier,
He sent for all the finny clan
And thus his farewell speech began:
"My friends," said he, "before I go
The way of all fish here below,
This legacy I leave, a plan
To circumvent that monster, man."
  At once there issued loud applause
From all the circle's gaping jaws.
For joy (in lieu of clapping hands)
They smote their tails against the sands.
  With conscious pride the veteran smiled,
And thus resumed in accents mild:
  "The fatal step, as I'm a sinner,
That ruins us is fish for dinner.
I own myself, in earlier years,
Before repentance sprang from fears,
I've eaten minnows, dace, and bleak,

Hundreds at least, or more, a week.
What toothsome food the rascals were,
And plump!—but that's nor here nor there.
While heedless thus we gormandize
Man stands above with watchful eyes.
He marks our haunts, he spies our ways,
Then right across our path he plays
In placid stream or purling brook
A live bait tethered to a hook.
Oh! ne'er can memory forget
That piercing pang—I feel it yet—
When first the barb's tenacious grip
Clung to my lacerated lip.
I rushed and tugged, and fought in vain,
'At each remove I dragged a lengthening chain.'
At last, impelled by wild despair,
With lively bound I leapt in air.
Flick went my tail, the line gave way,
Or else I'd not been here to-day.
But, oh! my friends," (he raised his eyes,
Devoutly turned towards the skies)
"Be warned while yet 'tis time, and flee
This fatal vice of gluttony.
Why should we prey on one another?
Is not the dace a fish and brother?
Believe me, worms and grubs and flies
Are most unwholesome luxuries.
The choicest morsels, rarest treat,
Are oftenest barbed with man's deceit.
Safe from his wiles in peace I feed
And mortify the flesh on—*weed*."
He ceased, and, with seraphic smile,
Beamed like a halo'd saint in "ile."
Amazement seized the scaly crew,
When thus the pike made answer due:—
"I must confess our friend the trout
Is somewhat late in finding out
That virtue, safety, all we need,
Lies in a vegetarian creed.
His arguments had moved me more
Had he propounded them before.
Now that his teeth are gone, his teaching,
From lack of practice, turns to preaching.

Perhaps old blood and feeble bones
Can live on weed, or snags, or stones!
A weed, forsooth, when one is ill,
May serve as a cathartic pill.
In my case Dr. Carp's prescription
Is of a different description.
He recommends of dace *quant: suff:*
Of gudgeon, minnow, bleak and ruff
Haustum quotidie capiendum
As long as Providence shall send 'em.
I can't find anything to shy at
In such a truly generous diet;
The new *régime* I'll gladly follow
When—I find nothing else to swallow."
Approval shone from every face,
When, lo! an uninvited dace
Came slowly wobbling past the chair.
"Insolent upstart, does he dare
To interrupt our conference,
And deem unscathed to get him hence?"
"No," cried the Trout, "for once my vow
I'll break, and teach the rascal how
To rue his beggarly intrusion."
He snapped him up. When, oh! confusion!
Once more he found his lip impaled.
Not now his youthful strength prevailed;
The friendly piles were far away,
And death had marked him for his prey.
The pike, amidst the consternation,
Thus spoke his funeral oration:
"My friends, our dear departed brother
Has left this world to try another.
Whether his fate shall be to fry,
Or stuffed to grace a wall on high,
These mysteries we may not pry.
I fear up there he'll have no need
To test his theories on *weed*.
I always warned him not to fast;
I fear his mind gave way at last.
He mixed, a melancholy fact 'tis,
A pound of theory to an ounce of practice.
As for us miserable sinners,—
We'd best disperse and get our dinners."
—*Land and Water*.

SAL TREES IN THE GARO HILLS.

ONE hundred and twelve sál trees in the Dambu forest, Garo Hills, on conversion yielded 1,065 sound logs, from which 148 broad gauge and 7,190 metre gauge sleepers were sawn.

This gives an average yield of 90 cubic feet per tree of marketable timber, but the careless sawing, and a too rigid specification of good sleepers, caused a large waste.

Our correspondent states that he has seldom seen a sál tree in Dambu exceeding 6 feet without a prominent heart-shake.

WE read in the "Cape Mercury" that the Comt De Vasselot, Superintendent of Forests in Cape Colony, is replacing Mr. D. Hutchins at King Williams Town, and that the latter officer is to be transferred to the Knysna, and we hope to hear from him regarding forest matters in this remote region.

WE regret to state that the Brandis Sylvicultural Prize could not be awarded this year, as the only competing Essay was in the form of a report and not a sylvicultural essay in accordance with the rules for the prize. The rules are now being revised, and we hope that next year some of the passed Dehra Dún Students will compete.

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THE FORESTS OF MANIPUR.

(*Continued from page* 344).

II.—The Valley and Mountains of the Central Division of Manipur.

The view of the valley of Manipur proper as obtained from the crest of the Limatol Range, is both beautiful and striking. Looking east and stretching north and south from the visitor's feet, a vast plain expands interspersed with rounded hills, sparkling lakes, and winding sluggish rivers, while far away to the east the panorama is closed in by rugged blue mountains, (the Hírok Ranges,) which, like the Limatol, extend almost in a meridional direction. At both extremities this fertile plain is hemmed in by the central hillocks, which rise higher and higher until they unite with the Limatol and Hírok Ranges—thus presenting the appearance of a verdant land-locked basin. The valley is indifferently cultivated; but bright green rice fields set off with clumps of dark-foliaged trees and feathery bamboos, mark the sites of scattered villages. A long straight path is seen to run from a small village and Police-station known as Bishenpúr at the foot of the Limatol Range, for 12 miles N. N. E., to what appears as a dense forest. This is the capital of the State—Imphail. The eye loses the detail of this somewhat monotonous expanse as the road dwindles into a mere gray line which is seen to be carried across the silvery tributary streams which descend from the Limatol mountains. Neither spires nor chimneys cut the blue sky, nor is smoke observed to ascend from the sylvan scene of the capital. Nothing in fact bespeaks the busy home of 30,000 to 40,000 people, and yet, hidden away among these trees, is the palace of the Rá'ú, and hard

by are the houses of his favourites—each family having a large enclosure around the homestead. Imphail may thus be described as a city of villages or rather suburban residences around the palace. Straight wide roads lined with trees, frequently intersecting each other at right angles, afford the means of communication; but neither shop, artisan, nor wheeled conveyance exists in the city. Industry and skill occur only in the distant rural homes. The people of the capital are the promoted favourites of the ruler who have had assigned to them plots of ground near the palace; and, in descending degrees in power of piracy, live upon the persecuted agriculturists of the State. Unique of its kind, the capital of Manipur is a Royal residence dedicated to luxury and amusement. All are happy. The streets are crowded with smiling healthy faces, in which few bear the lineaments of toil and labour. The children scamper after each other with merry shouts, or besport themselves in juvenile mimicry of the games and amusements of their fathers. There are no schools in the State, and Court favour and promotion are secured by success in the manly game of polo, or as it is called by the Manipurís—Khanjái. Coinage, one might say, is unknown, and the men are not allowed to trade. Imports and exports, excepting in certain articles that yield a Royal revenue, are practically prohibited. The women from the distant villages repair on certain days to the capital or to other recognised centres. Each carries on her head a neatly made square basket, in which has been placed the surplus stock of the homestead—the labours of her industrial skill or of her husband's agricultural knowledge. On reaching the market-place the contents of these baskets are exposed and exchanged or bartered, when each returns again to her family carrying off the results of her loud and hotly-contested exchange.

On market days the long straight road from Bishenpúr to Imphail may be seen crowded by groups of women hurrying to and fro, while the merry laugh is made to beguile the otherwise dreary march. Each wears an elegantly striped dress in bright colours made of silk or cotton. The stripes run along the length, and the top and bottom are neatly embroidered. This long piece of cloth is cleverly carried across the breasts and just under the arm-pits instead of round the waist, and is firmly tucked up, so that the top embroidered edge falls forward adding an additional fold to the garment, while the bottom edge reaches a little below the knees. The legs and arms are left exposed, but frequently a short green silk sleeveless jacket covers the upper part of the body reaching down to the top edge of the nether garment.

Along the stretch of dreary road these women hurry unmolested, and from the power given them as the only traders in the State, they by no means seem unhappy.

The contrast between the Cachar-facing densely wooded ranges and the slopes of the Limatol, bordering on the valley, is indeed remarkable. A grassy wall is seen to rise to a height of from 5,000 to 6,000 feet, the long gray monotony of which is only occasionally broken in the gorges by clumps of trees near the Naga villages. Large herds of cattle and buffaloes may be seen grazing on these rich grassy slopes, but the effects of the denuding of forest is everywhere seen. The rounded hillocks within the valley rise up exposing their barren red-clay heads, which on closer inspection are often seen to bear the stumps of old pine trees, ruthlessly hewn down for firewood, while no effort was made to replace them. The forests of the valley referred to as seen around the city are the sacred clumps of trees surrounding the homesteads; for, where not cultivated, the fertile soil of the valley bears but a malarious crop of rampant tiger grass. There are several lakes, but the great one to the south and east of Bishenpúr, the Logtak, need alone be specially mentioned. The valley of Manipur proper is an irregular oval, about 36 miles long and 20 broad, the southern and lowest portion being occupied by a vast expanse of lake and marsh. Near the capital the valley reaches its greatest altitude, being there 2,750 feet above the sea, but beyond the Logtak the land again rises with only one outlet for the water. Thus then, saucer-like, the valley of Manipur is hemmed in on all sides, and bears abundant evidence that the Logtag is perhaps but the remains of a lake or inland sea that once covered the whole area. Numerous salt springs exist, from which the Manipuris manufacture all the salt used in the State. The soil of the valley, with a recent top of humus, is a rich deposit of sand and mud. The rocks are all stratified and apparently of cretaceous age. Limestone occurs in one or two localities, and the streams often carry so much lime that the trees growing near their margins have their stems petrified or encased with lime up to the height of the highest flood. Every bough, twig or leaf that falls into these streams in a like manner becomes encased with lime, and so beautiful and delicate are the petrifications, that a leaf may be picked up in which the minutest reticulations are worked out in a limy deposit. To the east in the Kassome range, beds of carbonaceous shale or coal occur, which is never, apparently, used as fuel by the people. Slaty rocks are frequent, and quarried into large slabs, which are employed by the people to cover the roofs of their houses. On the Kabo side of Manipur

hornblende and ironstone are met with and also fuller's earth. In some of the hillocks within the valley, this fuller's earth is regularly excavated and sold in the bazars, being eaten by *enceinte* women. The iron ores where met with are regularly worked, and the spear-heads and swords used in the State are made of laboriously collected and carefully worked metal.

These are the characteristic features of Manipur. Each river basin, once or twice during its course, widens into saucer-like valleys formed from silted-up lakes, which may often be seen in the process of disappearance. Indeed the Logtak itself is studded with immense floating islands of weeds that are gradually subsiding under the accumulation of drift soil and decaying vegetable matter—agents which seem to have taken a no inconsiderable part in the drying up of the Manipur lakes. In many of the valleys, moraine-like walls are seen either running across, or fringing the sides. These appear to have been entirely formed by the rivers, which in time have cut through their retaining or containing walls, and thus left shattered barriers or skirting embankments to mark their former levels. Colonel Godwin-Austin explained these walls as due to ice action, but a recent geological explorer has attributed them to water alone. Be that as it may, rich shelving banks and flat valleys form a striking feature of Manipur, and where not cultivated, they bear an abundant herbage of tall grass, ferns, and herbaceous (often umbelliferous) plants, but are rarely, if ever, forest-clad.

Before proceeding north through a series of these lake-like valleys to the higher central division of the State, I must endeavour to convey some idea of the characteristic vegetation of the main valley of Manipur which embosoms the capital, Imphail. The moister portions of this valley may be said to have a closely-allied assemblage of plants to those met with on the Central Bengal mountains with a tendency, on the exposed red clay hills, within the valley, to types of a drier and warmer character, such as *Eriolæna spectabilis*, *Woodfordia floribunda*, *Terminalia tomentosa*, *Zizyphus*, *Capparis*, &c. A walk along any of the roads that penetrate through the assemblage villages which form the capital, would result in the discovery of most, if not all, the following species, for they are everywhere plentiful :—*Glycosmis pentaphylla*, *Vitex Negunda*, *Cleome viscosa*, *Icnocarpus ovalifolius*, *Flacourtia Ramontchi*, *Bryophyllum calycinum*, several species of *Solanum*, with, in the ditches and stagnant water, *Ottelia alismoides*, *Sagittaria*, *Alisma*, *Pistia Stratiotes*, *Lemna*, &c. On the damp banks *Colocasia*, *Commelyna*, *Jussieua repens*, and *suffruticosa*, *Marsilea*

quadrifolia, *Ipomœa aquatica*, and other such plants. In the hedgerows, and seeking the shade, *Rosa involucrata*, *Clerodendron* (a large double-flowered form), and *Buddleia macrostachya* and *paniculata*, *Hiptage Madablota* and *acuminata*, *Buettneria pilosa*, *Odina Wodier*, *Erythrina stricta*—the last two in great abundance, the red flowers of *Erythrina* being particular favourites with the Manipuris—while here and there along the road-sides occur *Ficus religiosa* (often forming sacred clumps with surrounding mud embankments and red painted stones), *Ficus hispida*, *F. uniglandulosa*, *F. obtusifolia*, *Artocarpus Chaplasha*, *Bauhinia variegata*, *Cratœva religiosa*, *Melia Azadirachta*, *M. Azedarach*, and an interesting and rare species, *M. Toosenda*, with *Cedrela Toona*, bamboo, and, on shady banks in grassy situations, *Potentilla supina*, *Inula Cappa*, *Polygala leptalea*, *Osbeckia stellata*, along with other such sub-tropical herbaceous plants. It is interesting to add that, dispersed among these indigenous plants occur many of the invading foreigners that are claiming so much of tropical India, such as *Argemone mexicana*, *Bixa Orellana*, *Jatropha glandulifera*, *Nicotiana Tabacum*, &c. In the lakes also, the American Duck-weed (as in Bengal tanks) threatens to exterminate the indigenous plants. I must not omit to mention another introduced hedgerow plant, which perhaps a few years hence, we shall learn has left the garden enclosures and advanced into the jungles—*Datura suaveolens*. This elegant plant, with its pendulous white flowers 6 to 8 inches long, seems quite acclimatised, and to be much appreciated by the people.

Of cultivated fruit trees the mango, with large stone and inferior fruit, occurs occasionally, and along with it *Prunus persica* (the peach, gone wild on the hills near the sites of deserted villages), *Elæocarpus floribundus*, and a plum, which I take to be new to science, and which provisionally I name in honour of Manipur—*Prunus manipurensis*. This has a leaf not unlike that of *Rhamnus dahuricus*, and the fruit, small, shining green, is covered with curious tubercles. It is not very luscious, being of a sour-sweet flavour, but is much relished on a hot march. This fruit I made acquaintance with in February, on a march from Manipur to the north. Some 11 miles from the capital, as we were nearing the village of Sengmai, my men ran up the side of a sloping ledge, to a small village to purchase fruits and vegetables. I followed and found a basket of this fruit exposed for sale. A reward offered for a branch of the tree, secured for me some half-an-hour after, a bough with the fruits attached. Two months, subsequently, on my return to Manipur I made every effort to see the tree, but failed. I

presume it is, therefore, not plentiful, and I have not seen the flower which doubtless appears in Autumn. The fruit is, however, so peculiar, that there can be little doubt but that the isolated State of Manipur possesses in this, a peculiar and characteristic plum which may have been cultivated there for centuries without, so far as I have since been able to discover, having left the State. In this connection it is worthy of remark that while working through the collections of *Prunus* in the Calcutta Botanic Garden's Herbarium, I came across a specimen collected by Oldham in Japan (No. 190), which seems closely allied to the Manipur plant. It would not indeed be at all surprising were it proved to be identically the same form, since a strong Japanese taint exists in Manipur, such for example as the appearance in the forests to the north of a species of the Sacred Star Anise tree of Japan. The specimen collected by me has been examined at Kew, and pronounced to be a new species of *Prunus*, so that it seems probable the above name may come to be accepted as sufficiently justified.

Before passing away from the immediate vicinity of Imphail, I may as well say something of its lake vegetation. Selecting the Logtak for that purpose, I would only add here that the lakes are so much alike, that what I say of one applies practically to all. The American Duck-weed, along with *Salvinia imbricata*, *Azolla pinnata*, *Lemma* and *Pistia Stratiotes* form so dense a scum that boating is often impossible, excepting along the channels kept clear by the fishermen. The graceful leaves of *Nelumbium speciosum* form dense expanses, within which thousands of duck and teal besport themselves. The sacred Lotus is indeed so plentiful as to remove all suspicion of its not being indigenous, but strange to say, the blue, white, and red, water lilies of the Bengal tanks are remarkably scarce, their place being taken by the prickly leaved species *Euryale ferox*. This affords an edible fruit which is sold on the roadsides of Manipur, the baskets of the curiously dissected sopari-nut (*Areca Catechu*) and the spiny *Euryale*, recalling the baskets of sea hedge-hogs, exposed for sale in Mediterranean coast towns. *Trapa natans* takes the place of the ordinary singara nuts of Bengal (*T. bispinosa*); and great boat loads of this nut may be seen punted up the rivers from the Logtak lake to the town. A large yellow-flowered *Limnanthemum* disputes possession with the white-flowered species—*L. indicum*, and *L. cristatum*. This is particularly abundant in the moat around the Raja's palace, and seems to me to be quite distinct from the two Bengal species mentioned above. I identified it as *L. Kleinianum*, Griseb, a form which appears from the Flora of British India to be referred to *indicum*.

If this be so, then surely there is but one species of *Limnanthemum* in all India, for it would be difficult to point out two plants more unlike than the ordinary small white-flowered *L. indicum*, and this large elegant plant, which at a distance recalls the yellow water-lily of Europe—*Nuphar lutea*. Floating or submerged in the Logtak lake, or growing on its subsiding islands, were gathered *Valisnaria spiralis*, *Potomogeton crispus*, *P. oblongus*, *Scirpus lacustris*, *Juncus Leschenaultii*, *Fimbristylis rigidula*, *Myodendron ignium*, *Utricularia flexuosa*, *Lycopodium squarosum*, *Carex nitella*, *Colacasia*, *Alisma*, *Sagittaria*, &c. From the shallow margins were procured various species of coral-like *Chara* and *Nitella* seem glistening in fairy banks, through which brilliantly coloured small fish darted in sportive chase, or flashed from clump to clump on being disturbed by the splash of the oar. Dreamily the large cray-fish were seen crawling along, while over the mirror-like surface myriads of aquatic birds disported themselves, their gay plumage reflected in the diamond drops of water glistening over the leaves of the water-lilies. On the mountain-islands *Callicarpa*, oak, *Cycas*, *Phœnix*, and pine, form a rich arborescent and brushwood contrast, which greatly enlivens this tropical lake scenery, while affording a curious but charming confusion to its floral characteristics. The *Cycas* occurs (as far as my experience of Manipur goes) only on these humid island-peaks, while the alpine date-palm re-appears on the mountain ranges to the east. It may be here mentioned in passing that in many of the Reports on Manipur issued by the Political Residents, it is stated that palms do not occur in the State. This is quite a mistake: the alpine date-palm is common, the sago-palm by no means rare, and the bridges over the rivers are invariably constructed from the climbing palms or rattan canes which occur in profusion both in the eastern and western forests.

Space cannot be afforded to deal in detail with the cultivated plants found in the valley. Rice is the staple crop, and there are some 20 to 30 recognisable forms grouped in two sections—early and late. The early ripens in three months, and is harvested in September. Of this class there are four kinds. The late rices take six months to reach maturity, but the majority of the best rices belong to this class, and they are reaped in November. Wheat to a small extent is sown in Autumn and reaped in Spring. Cotton is rarely grown in the valley of Manipur, but is largely raised by the hill tribes on the adjacent mountains, and is sold in Manipur, where it is spun and woven. On the hills, as an escape from deserted cultivation, semi-wild cotton of a very inferior quality is commonly met with. Many forms of pulses and lentils are grown, including dál, kesari, múng

and soya. There is a form of *Lathyrus* cultivated, which I take to be a perfectly distinct species, and which I have named *L. imphailensis*. English vegetables, peas, beans, &c., are grown throughout the year, and potatoes of an inferior quality have become a regular article of diet with the Manipuris. The sopari-nut has to be imported from Cachar, but the betel leaf is largely grown locally, as all the Manipuris have become inveterate chewers of pán since they became Hindus. The plantain is seen in most gardens, and the pine-apple succeeds admirably. Silk-worms are reared by about 300 families of a low caste, and the mulberry tree on which the worms feed is allowed to grow wild in certain valleys. No care is bestowed on the selection of either plant or silk-worm stock; the process of reeling is primitive in the extreme, and yet excellent silk garments are sold in curious triangularly folded pieces.

Perhaps the most striking agricultural product in Manipur is a Primulaceous plant, regularly cultivated as a green vegetable to be eaten along with fish. This is a species of *Lysimachia*, known to the Manipuris as *Kengoi*, and is probably *L. obovata*, Wall. It is closely allied to *L. caudata* of China, if the two should not be viewed as the same. This is perhaps also Hance's *L. Samolina*. But the fact that a *Lysimachia* is actually eaten as a pot-herb must be regarded as extremely interesting, for hitherto almost no primulaceous plant has been recorded as used for any economic purpose. One or two *Lysimachias* are stated to have doubtful medicinal properties. *L. fœnum-grœcum*, Hance, the author states is used for perfuming hair oil in China, but he adds that he thinks "it might be profitably employed in the compounding of cattle food." It seems probable that all the translucent gland-dotted *Lysimachias* may be found, as in present instance, to be wholesome if not sufficiently distinct in other respects to justify their separations as a sub-genus. They all recall the genus *Mœsa*, and may thus be viewed as affording an additional link of connection between *Primulaceæ* and *Myrsineæ*.

Of dye stuffs may be mentioned *Carthamus tinctorius*—safflower, *Strobilanthes flaccidifolius*—rúm, kúm, or indigo—and madder, but strangely enough the madder of Manipur is *Rubia sikkimensis* not *R. cordifolia*. Of fibres, cotton and silk are all that the State produces, and of resins the kind of Japan varnish met with also in Burma, namely *Melanorrhœa usitatissima*. Tobacco is largely grown, but in the valley *Nicotiana rustica* is the form chiefly met with, while on the hills *N. Tabacum* takes its place.

(*To be continued*).

DR. CLEGHORN'S SERVICES TO INDIAN FORESTRY.*

SINCE Forestry is now recognised as an important business in India; since it has become possible, by means of protection, and chiefly by means of protection against the annual ravages of fire, to convert the poor jungles of olden days into dense, well-stocked, and productive forests, which yield a large and steadily increasing revenue,—and mainly since experience has shown that Forest Conservancy, instead of doing harm to the people of India, promotes their well-being, and is a blessing to them and their country,—the question has, naturally, often been asked and discussed, in which part of the British Indian Empire was Forest Conservancy first started?

In the beginning of the century the Government of Bombay established a timber agency on the western coast of the peninsula, in order to secure a permanent supply of teak timber for the Government dockyards at Bombay. In 1847, Dr. Gibson was appointed Conservator of Forests in Bombay, and ever since that time attempts have been made, with more or less success, not only to work the Government forests of that Presidency, but also to secure their maintenance, to protect and to improve them.

Soon after Tenasserim had become British territory in 1826, repeated, but at that time mostly ineffectual attempts were made to effect the protection of the teak forests in that province.

In the Presidency of Madras, Mr. Conolly, the Collector of Malabar, commenced (1843) planting teak on a large scale at Nilambur, and this was the beginning of those famous plantations, which have since been steadily extended by the Madras Forest Department, and which are now reported to cover 3,500 acres.

The object of the present paper is not to decide the question, whether Madras or Bombay may claim the honour of having first started Forest Conservancy in India, but to set forth the share which Dr. Cleghorn has had in this business; and hence it will be necessary to review somewhat more fully what was done in this respect in the Madras Presidency, where Dr. Cleghorn commenced his labours.

In May 1847, Captain Frederick Conyers Cotton (now Major-General and Companion of the Star of India) reported to the Government of Madras on the teak in the Anamalai hills, and asked

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* By Sir D. Brandis, K.C.I.E., late Inspector General of Forests to the Government of India. Reprinted from the Proceedings of the Royal Scottish Agricultural Society, July 1887.

for the services of an officer to explore the forests. The sanction of the Government of India having been obtained to this proposal, Lieutenant James Michael (now Major-General and Companion of the Star of India) was appointed in June 1848. In August 1849, the Court of Directors called for reports on the results of Lieutenant Michael's work. The terms of the despatch are well worth recording, as evidence of the just views entertained at that time by the Court of Directors. They wrote: "We trust that effectual measures will be taken for its conservation (of the Anamalai forest), so as to protect it from the serious injury which other forests have sustained."

Captain Cotton then submitted a report on the operations of felling and converting teak, the making of a road across the hills, and the settlement of the Colengode and Cochin boundaries. He also reported the number of good teak trees standing—

In the Cochin disputed territory,	...	107,000 trees.
In the Colengode „	... ...	28,000 „
In the Government territory,	... ...	61,700 „
Total,	...	196,700 „

Minutes were written on the subject by Mr. D. Elliot, Member of Council, and by the Governor, Sir H. Pottinger, and in February 1850 the Government sanctioned Lieutenant Michael's services being retained. In February 1851 he was sent to Moulmein to learn the methods of dealing with heavy timber, in December 1853 to the Kanara forests, and in 1854 he was formally appointed Superintendent of the Anamalai forests. The published reports (selections from Madras Records, No. V. of 1855) deal only with timber and roads, and there is no reference to conservancy. Lieutenant Michael, however, did more than this—he brought about the lease of valuable teak forests from the Nambadi of Colengode, and he started a system of clearing teak seedlings, and young teak trees, of dry leaves and other inflammable matter in the forests, so as to protect them against injury by the annual fires of the dry season.

In 1856, Lieutenant Michael went on leave, and Captain (now General) Douglas Hamilton was appointed in his place. He was in charge of the Anamalai forests for several years, and at a later date—after a regular Forest Department for the whole Presidency had been organised—Captain Hamilton was succeeded by Lieutenant (now Colonel) Beddome.

About the time that Captain Cotton first drew attention to the Anamalai forests, Dr. Cleghorn was stationed as an Assistant

Surgeon at Shimoga, in the Nuggur Division of Mysore. Being interested in botany and a keen observer, he remarked the wholesale destruction of forests in that district, chiefly through "kumri" cultivation. It was mainly through his representations that the attention of Sir Mark Cubbon, then Commissioner of Mysore, and of Colonel Onslow, the Superintendent of the Nuggur Division of that State, was drawn to the necessity of Forest conservancy. Dr. Cleghorn's name is mentioned in a Report on the Conservation of Forests, which the last-named officer submitted to the Commissioner in May 1847.* In consequence of this report and of Dr. Cleghorn's representations, kumri cultivation was stopped in the greater part of Mysore and Coorg; and in 1868, while on a tour of inspection through these districts, the writer of this paper had the satisfaction of seeing large tracts of country clothed with well-stocked young forests, which had grown up on the old kumri clearings.

In 1850, the British Association for the Advancement of Science, at their Edinburgh meeting, appointed a Committee to consider the probable effects, in an economical and physical point of view, of the destruction of tropical forests. The report was drawn up by Dr. Cleghorn, and was submitted to the Association, which assembled at Ipswich in 1851. The other members of the Committee were: Professor Forbes Royle, Captain R. Baird Smith, and Captain (now Lieutenant-General) R. Strachey. This report gave an exhaustive review of the question as it then stood, and as far as it related to India, and it contributed much to induce influential members of Government in India and at home, seriously to consider the necessity of organising systematic measures of Forest Conservancy in India.

In the Bengal Presidency it was Lord Dalhousie himself who, as Governor-General of India, carried through effective measures for the conservation of forests, chiefly in the newly-acquired province of Pegu; while in Madras Lord Harris took steps in the same direction. In August 1856, Dr. Cleghorn submitted a report to the Government of Madras, containing proposals for establishing Forest Conservancy. These proposals were sent up to the Government of India for sanction, which was accorded in November; and on the 19th December, 1856, Dr. Cleghorn was appointed Conservator of Forests in the Presidency of Madras. An account of the work accomplished during the first five years

* Report of the Twenty-First Meeting of the British Association held at Ipswich in July, 1851, p. 83.

of his tenure of this appointment is contained in three general reports and other official documents, which, with other important unofficial papers, will be found in a little book, entitled, "Forests and Gardens of South India," published by Dr. Cleghorn in 1861, when compelled to come home on sick leave. This book has done much to promote Forest Conservancy in India. The reader must not expect to find in it the record of a complete and scientific system of forest administration, the introduction of which, under the circumstances, at that time would not have been feasible. But the record of the work accomplished by Dr. Cleghorn during this period shows that he directed his attention to such matters as called for immediate action, and that his recommendations in regard thereto were in the right direction. He justly laid great stress upon the necessity of acquiring a good knowledge of the principal trees and shrubs, as well as of the climate, soil, and forest growth in the different forest tracts; he arranged for the supply of timber, charcoal, and firewood; and in regard to the protection of the forests, he studied the chief sources of injury, indiscriminate cutting, fires, and kumri cultivation. The result of his persistent representations was, that by an order of May 1860, the Government of Madras prohibited kumri cultivation in Government forests without previous permission, and directed that this permission should be given sparingly, and never for spots in the timber forests. Dr. Cleghorn had thus accomplished for the Madras Presidency the same result which, thirteen years previously, he had helped to bring about in Mysore, and in both cases the result accomplished through his persistent representations has been most beneficial for the country and its inhabitants. Dr. Cleghorn was able to carry his point in this matter, because he was known to be a true friend of the natives; he entertained feelings of warm sympathy towards them, and had made himself familiar with their mode of life and system of husbandry. As a medical man his name was widely known, and he had acquired much influence among the native population. When urging the discontinuance of kumri cultivation in Madras, as he had previously urged in Mysore, he knew that he was proposing measures which in the end would be highly beneficial for the people themselves. Dr. Cleghorn's single-minded desire to promote the welfare of the people was known to those who at that time were in influential positions in Madras, and the confidence which they placed in him was the secret of his success in this important matter.

At a later period kumri was unfortunately again permitted in Mysore, and in Madras the beneficial effect of the order of 1860

has subsequently to a great extent been rendered nugatory by the tendency, which for some time prevailed in that Presidency, to regard as private property a large portion of the forest lands, particularly in South Kanara, that had formerly been considered to be the property of Government. These subsequent mistakes, though they have done great injury to the country and its inhabitants, do not in any way diminish Dr. Cleghorn's paramount merit in this matter. He paid great attention to a proper arrangement of cuttings, so as to secure the maintenance and promote the natural reproduction of the forests. Under his direction numerous new plantations were established, while existing plantations were maintained and extended. Establishments for the protection and proper management of the forests were organised in all districts. The time had not yet come for comprehensive forest legislation, but local rules were issued by Government on his recommendation, which for the time being were sufficient.

On Dr. Cleghorn's return to India in November 1861, he was directed by the Governor-General in Council to proceed from Madras to the Punjab, in order to examine the forests in the Western Himalaya, with a view to obtain reliable information regarding the timber resources of that province, and to institute a systematic plan of conservancy and management. The exploration of the forests in the hills occupied the summer months of 1862 and 1863, while the winter months were devoted to the inspection of timber depôts, brushwood tracts of the plains, and the preliminary arrangements necessary for the formation of the Department. His report on the forests of the Punjab and the Western Himalaya, which was published in 1864, sets forth the results of his work, and has been of great value in facilitating the organisation of forest administration in that province and in those Native States of the Western Himalaya where it was possible, by means of leases, to obtain the control of the forests. His work received from the Lieutenant-Governor of the Punjab great praise, and the Governor-General in Council expressed his concurrence in the high estimation entertained by the Punjab Government of his services.

Meanwhile (in October 1862) the writer of the present paper had been summoned from Burma, where he had been in charge of the forests since January 1856, to advise the Government of India in the general organisation of forest business. On his recommendation, Dr. Cleghorn was associated with him on the 1st January, 1864, and remained in that capacity attached to the Government of India until 1st March, 1865. Previously, in August 1863, these two officers had drawn up a joint memorandum,

which was sent to the Government of Madras, and which urged the necessity of early demarcation of the Government and village forests in the Madras Presidency. These proposals were not, however, at that time approved by the Madras Government, and it may here be added that, in spite of the persistent representations subsequently made on the same subject by the Government of India, no adequate action was taken in Madras towards effecting a separation of the various rights and interests in the public forests and waste lands until the Madras Forest Act was passed in 1882.

In April 1866, while the writer of the present paper was on leave in Europe, Dr. Cleghorn was appointed to officiate as Inspector General of Forests until April 1867, when the thanks of the Government of India were conveyed to Dr. Cleghorn for his long and successful labours in the cause of Forest Conservancy in India. On his return to Madras, he resumed his work in that Presidency with his former zeal and industry. That, nevertheless, during that period much less progress was made in the forests of Madras than in those of other provinces of the Empire, was due to the views of the Government of Madras, which at that time began to manifest themselves. Dr. Cleghorn retired from the service in 1870, but has since been employed every year at the India Office as a confidential adviser to assist Her Majesty's Secretary of State in the selection of Candidates for the Indian Forest Service.

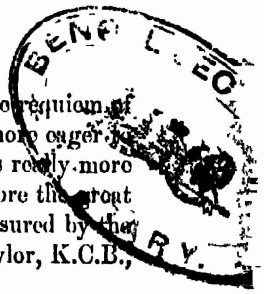
When Dr. Cleghorn laid the foundation of an effective system of Forest Conservancy in Mysore and Madras, Forestry was very little known in India. A commencement had been made in several places, but Dr. Cleghorn was the first to carry out conservancy measures on an extensive scale. His aims were large and comprehensive, but the single-minded devotion to the task which he had set himself gained the confidence of many who might otherwise have been hostile to the new measures advocated by him. A public resolution by the Government of India, of 10th January, 1865,* justly designated him as the founder of Forest Conservancy in India, and added—"His long services from the first organisation of forest management in Madras have without question greatly conduced to the public good in this branch of the administration; and in the Punjab also Dr. Cleghorn's labours have prepared the way for the establishment of an efficient system of conservancy and working the forests of that province."

Since Dr. Cleghorn's retirement from the Indian Service, he has done much for the promotion of Forestry in Great Britain,

* Parliamentary Return on Forest Conservancy, Part I., India, 1871, p. 95.

particularly through the Royal Scottish Arboricultural Society, of which he became a Member in 1865, and of which he has been President on two occasions—from 1872 to 1874, and from 1883 to 1886. It was in a great measure due to his exertions that the International Forestry Exhibition of 1884 was held with such marked success at Edinburgh.

PRIZE DAY AT COOPER'S HILL.



Some of the Indian daily papers have been singing the requiem of the Cooper's Hill College, and we are therefore the more eager to prove to our readers that this very useful institution is really more vigorous than ever, and whilst some of its critics deplore the great expense caused by the College to India, we are now assured by the President of the College, General Sir Alexander Taylor, K.C.B., that last year's income fully covered the year's outlay.

The Secretary of State, Lord Cross, was unable to be present at the annual Prize Day of the College, which was on the 25th July, and in his place Sir John Fowler, a past President of the Institution of Civil Engineers, distributed the prizes.

Amongst the guests present were Field-Marshal Lord Napier of Magdala, the permanent Under Secretary at the India Office, Mr. Godley, Sir Alfred Lyall, Sir Charles Turner, Sir Charles Bernard, Sir Lepel Griffin, Sir R. Strachey, and many others, the better known of whom were loudly cheered by the students, and who have, it is hoped, more feeling for those amongst them who may join the various Indian Services, in spite of the dreary prospects held out by rupee pensions, than that shown by Sir Richard Temple and Sir George Campbell in the recent debate in the House of Commons.

In giving his report on the progress of the College, General Sir Alexander Taylor made a long speech, from which the following extracts will be of special interest to Forest officers :—

* * * * * *

"I cannot have a better preface than the announcement that the report I have to make to-day is a very satisfactory one. I may fitly commence by drawing attention to the fact that during the last few years the College has grown a good deal—has indeed grown very largely. I find that in September 1882 the number of gentlemen forming the staff of the College was 15. It is now 26. I find also that the number of students in September 1882 was 90. Last September it was 139. During the last five years we have thus grown greatly in numbers. We have also greatly expanded in another direction. We teach many more sub-

jects than we used to do. The Forestry branch has recently been established, and it alone has brought with it four new subjects, namely, Botany, Organic Chemistry, Entomology and Forestry; and we organise for the Forest students an annual visit to forests in Great Britain, and also a tour of three months to forests on the Continent. We also do a good deal of work of another kind which we used not to do. We do a large part of the chemical testing of metals, Portland cement, Indian-rubber, paints, varnishes, &c., required in connection with contracts under execution in this country for the Government of India, as well as, I believe, the whole of the mechanical testing of metals and chains required in the same connection. And lastly, we have expanded in income. The year's income fully covers the year's outlay. So on many sides we have enlarged, and I hope that I may say this expansion has been attended with advantage to all concerned.

"There are to-day 127 students, of whom 39 having completed their college course leave this afternoon. The 39 comprise 27 Engineer, 2 Telegraph and 10 Forest students.

"Turning next to the Forestry branch. Ten students leave the College to-day. They go for a visit of three months to the Continent to study practical forestry, under the distinguished guidance of Sir Dietrich Brandis, in forests which have been under systematic management for a considerable length of time. On the conclusion of this visit, the work they have done during it will be reported on, and their places on their order of merit list will then be revised and finally fixed. The Forestry branch has I have said, been but recently established. The length of the Forestry course has been fixed at 2½ years, and we are sparing no exertion to make the most of it: but we find it a very short time. We have had the immense advantage of having at the head of the branch the Inspector-General of Forests to the Indian Government, Dr. William Schlich, to advise and guide us. Without his help our progress must have been much less firm and less rapid. We have also been most fortunate in having the assistance of Mr. Marshall Ward, Professor of Botany, who has thrown himself with great energy and success into that particular line of botanical teaching which we want in order to lay solidly one of the most important foundations of the study of Forestry. The present is the second set of recruits for this branch of the Service that has been trained here, and its training has in some ways been more complete than that of its predecessor. With experience have come improvements, from which these gentlemen have profited. They have also exerted themselves with very considerable success, and Dr. Schlich is well satisfied with them. Last year Rogers, a most distinguished student to whom was given a special scholarship by the Vice-President of the Council of India, made 78 per cent. of possible marks. This year Osmaston has eclipsed him, making 80 per

cent. There are but few subjects which the Forest and the Engineer students take up on precisely the same platform; but in one of these subjects a Forest man is first, Monro, in competition with 46 others, is first in Physics, being one mark ahead of Craven. The figures are: Monro 70, and Craven 69, marks.

"So far this report has had reference only to those students who have now completed their studies here. Of the remainder of the College I have to speak in more guarded language. These gentlemen have not yet come to the end of their course: they still have time before them. Of the Engineer students I would say that they will have to make a good struggle if they mean to reach the standard of their seniors now leaving: but this exertion I have confidence that a good proportion will make. Of the junior Foresters Dr. Schlich speaks well and hopefully. Caccia stands first with a total of 81 per cent. of possible marks comparable with 73 per cent. made by the best man last year. So far he has thus done remarkably well. Again, in first year Surveying Clutterbuck has done well. He is at the head of the list, placed equal with the Engineer student A. R. Walsh."

After reading out the list of the scholarships granted to the Engineer students, and referring to Mr. Currie's liberality in giving £1,000 of 3½ per cent. India Stock for a scholarship for Applied Mechanics, we read that the President's scholarship of £20 for the best Forest student was given to Mr. Osmaston. Sir A. Taylor referred to the progress made in the different subjects taught at the College, and to the athletics, remarking that the students had not time to practice sufficiently at boating and cricket to achieve any signal success, but that in jumping, 20 feet 9 inches was not a bad performance for breadth, nor 5 feet 4½ inches for height, and that lawn tennis gives a deal of useful exercise in a moderate amount of time.

The students form O Company of the Berkshire Volunteers, 116 rank and file, all efficients.

The President concluded his address with the following general remarks, which we can all endorse:—

"Gentlemen,—I have now to say a few words to you. I will not detain you long, and I address myself specially to those among you who are about to enter the service of the Indian Government. Last year, and on the previous occasion also, I drew your attention to a feature in the character of the men of Northern India which, in my somewhat long service, I had found to be quite marked. I put before you their warm appreciation of kindness; and I illustrated their readiness to requite such kindness with strikingly faithful and plucky service, giving you facts drawn from my own personal experience. My object was to enlist your

kindly feelings, particularly at first starting, towards the people among whom you are about to live. Later on these feelings will warm up or cool down according to your own experience, but I greatly desired to secure a favourable start. I do not intend to say anything more on that subject to-day. What I purpose doing on the present occasion is to endeavour to get you to realise how great is the position Englishmen occupy in India; and when you have to some extent realised that, to get you to make up your minds to live up to the responsibilities it entails and to the opportunities it offers. Perhaps I can best bring the state of the case home to you by asking you to consider how it has come about that what is by comparison a mere handful of Englishmen rule the 250 and odd millions of India. And not only do that, but so do it that the millions desire to be ruled by them. How has that come about? What are the causes? They seem to me to be obvious enough, and I take them to be these. We are in the main God-fearing people. We love honesty, truth, justice and mercy, and we hate oppression and tyranny. These are the marked characteristics of our rule, and to my thinking they are the key to our success. But are they sufficient to account for the results we see? I have no hesitation in saying that in my judgment they are: indeed, I may go further—I cannot imagine any other explanation at all sufficient to account for the wonderful position we hold in India. Under these circumstances I ask you what manner of man an Englishman out there is bound to be; and not only that, but is bound to *show* himself to be? The answer to this question also seems to me to be clear enough. Circumstances force on him great responsibilities. Whether he likes it or not he is in a very special sense a representative man. He lives under this constant stimulus, and he can hardly fail to feel that he is in a very exceptional degree bound to cultivate and to show forth those qualities which have made the Englishman's rule in the East the blessing it is: that he is bound not only to be, but to show himself to be, a God-fearing, manly, Christian man, loving honesty, truth and justice. I ask you, gentlemen, to think over these things, and then in your Indian life to have the courage of your convictions. With these words I bid you all good bye. May you each have a prosperous, useful career; and when you come back to the old country bye and bye, may you have the comfort of knowing that in your working days you recognised what your duty was and tried hard to do it."

The list of fellowships, scholarships and of the prize holders was then read out, and the prizes distributed by Sir John Fowler, who then addressed the company present as follows:—

"Expressing his sympathy with the assembly at the absence of Lord Cross, whose official knowledge and many gifts would have made the proceedings exceptionally interesting. In return, he asked of the meet-

ing its sympathy with him at being called upon so suddenly and unexpectedly to occupy the chair (a laugh). He was quite sure they would extend to him their sympathy. Proceedings such as those in which they were engaged were always pleasant when everything was so thoroughly satisfactory as they found it in the President's address, and he thought that his own particular duties as Chairman became comparatively easy. They were told that the past year of the College was the very best it had ever had. The President told them in words which were understood by every student especially that they had beaten the record on nearly every point. In one thing he was personally much interested—the lowest man in some particular branch of study, which he did not recall, had obtained more marks than had been made by the lowest man on any previous occasion. This was highly satisfactory. (Loud applause.) For himself he entirely sympathised and agreed with the remarks of the President as to the necessity of playing as well as of working. (Applause.) Very few men, he thought, had worked harder during their lives than he had: and few men, he was proud to say, had played more than he had. (Laughter.) He did not believe in any man—young or old—ever achieving permanent and real success and doing thoroughly good work if he confined himself entirely to his study and his office. (Hear, hear.) To do good work the body must be kept wholesome and strong as well as the mind vigorous, and these conditions could only be reached by exercise and out-door play. He therefore would recommend them—though he dared say they would do it anyhow (laughter)—to continue to play as hard as they had done up to the present. (Hear, hear). Instead of making a special apology to them for his position at that moment, he would boldly ask them to take certain things which he but before them as some justification for his being in the chair on this should interesting occasion. These were his long and well-known attention to, and sympathy with, the education of the engineer; and, in the next place, the fact that he was at a critical moment in the fortunes of the College able to do his little to continuing it as a school of engineering. As long ago as 1866, when the members of the Institution of Civil Engineers did him the honour of electing him as their President, he made the education of the engineer the subject of his inaugural address. The Government of India were good enough to have that address of his printed and circulated, and many a young engineer in India—probably some of those present—would no doubt read it in that form. It was interesting reading now for various reasons. On some subjects—he would instance that of steel—it was perhaps a little out of date, for he was only able at the time to refer to steel as a metal very well worthy of attention. (Laughter.) They knew what had been done with steel since—its extraordinary results. But in other respects, on the general principles

of the address, he had nothing to add, and little to alter. At that time Cooper's Hill College was not in existence. Nor, as far as he knew, was there any similar institution: therefore the young engineer of that date had not the advantages—the great and enormous advantages—which the students of this day possessed. So much upon the first point—his sympathy with engineering education. As to his connexion with Cooper's Hill, it arose in this way:—At a certain date the Government of India were unable to give employment to the Cooper's Hill students who had qualified in the examinations according to the practice which had obtained up to that time. Upon that it became a matter of serious consideration whether the College should be continued under new conditions or given up altogether. Lord Cranbrook was Secretary of State at the time, and his lordship was good enough to put the papers on the subject into his hands, and to ask his advice as to what it would be best and most prudent to do in the circumstances. Of course it was evident that if the College was to go on it must be understood that it was continued as an experiment only. After looking into the matter with such care and thought as he could give to it, he took upon himself the responsibility of advising that the experiment should be made, provided the Government of India felt itself at liberty to give a certain limited number of appointments annually. His views with those of other persons were then carefully examined and sifted. It was an important question to decide, and ultimately the matter was decided as he had advised. (Hear, hear, and applause.) He was very happy to think it was so decided, because the result of the continuation of the College has been thoroughly and completely satisfactory. (Hear, hear.) Probably the change in their circumstances was beneficial; in fact, he would go further, and say it was beneficial: since it compelled a great deal of wholesome competition and rivalry between that and other kindred institutions which had by that time grown up around them; and this notwithstanding the decrease of the number of appointments given to the College. It was understood that unless Cooper's Hill could do as good work and produce as good men, as other colleges—unless its President and staff were equal to those of other institutions in the general results of their work: unless the men were as well equipped for the profession which they sought to enter from that College as the men from other colleges—Cooper's Hill could not be continued. And so it came about that after some little disappointment from the falling-off of the number of the students, due, of course, to withdrawal of a certain number of appointments, there had been a great improvement in the work done at Cooper's Hill, and to-day the young men who went from that institute abroad into the world were —he did not like to say anything against the men of the past, who had not their advantages and opportunities: but the work done was greatly

superior, and the students were now much better equipped than those who worked under the old arrangement. (Hear, hear.) Another thing which influenced him in advising as he did was the knowledge of the grand position which that place occupied. It seemed to be hard and cruel that it should be given up and that a great teaching establishment should be dispersed. The College was in existence; everything was in trim; and taking it altogether he thought they might congratulate themselves on the issue of that question. He believed the Government of India felt they came to a right decision when they determined to take some further responsibility on themselves and continue Cooper's Hill College. (Hear, hear.) Finally, he had a few words for the engineering students before him. He noticed that the President spoke chiefly to the men about to go to India, but there were students who were not going to the East. (Hear, hear.) He begged to say to such that the present was a time when competition was very keen in everything connected with their profession, and it was quite impossible that any young man could succeed in life unless he was at least as well equipped for his work as those with whom he had to compete. And just now it was not only a question of young English engineers competing with each other, but the energetic, pushing Germans were competing with them in every part of the world as well as in England itself. Therefore he ventured to warn them that to be successful they must still go on—still continuing to beat the record annually if possible, but if not, as often as might be. They must not be content with the report of to-day good as it was: they must produce a better next year, and a better, and a better, for the honour of Cooper's Hill and for their own future success. They would be told, no doubt, that the profession of engineering was at the present time in a very flat condition. Of course engineering was influenced by the rise and fall of trade. Enterprise followed good trade, and just now trade was not over good, so that they suffered with other people. But even now, and for as long a time as any of them need to care about it, there would be engineering work to do in many parts of the world, and if they were thoroughly equipped and prepared to go to distant lands to do it, they need not fear that they would fail of proper employment in the future. Of course there must be vicissitudes; they could not always be swimming with the tide; but, taking it generally, he did not think that any young man who was capable need fear greatly for the future. The addition of Forestry to the subjects taught in the College had been a great success, and he was glad to see that some of the men in that branch had competed successfully with the engineers in certain matters which, strictly considered, belonged to neither of them. From his own experience he could say that one branch of work—engineering for instance—was greatly assisted by as much information as possible in

other branches that only indirectly belonged to it. He had been deeply gratified by the report of the year's work, and he heartily congratulated the President and staff, and all other persons connected with Cooper's Hill, upon the good work they had achieved. For their sympathy to himself in the unexpected position in which he had found himself he was deeply obliged. (Loud cheers)."

After cheers being given for Mr. Currie, Vice-President of the Council of India, for Sir J. Fowler, and for Sir A. Taylor, the company took luncheon with the President and returned to London.

The following is the list of the Senior Forest Students, the successful ones among whom may be expected to come out to India next cold weather:—

Osmaston, B. B.	Branthwaite, F. J.
Haines, H. H.	O'Bryen, E. A.
Monro, A. V.	McArthy, C. D'A.
Carter, H.	Tottenham, W. F. L.
Blunt, A. W.	Thompson, H. N.

ANNUAL MEETING OF THE AMERICAN FORESTRY CONGRESS.

(*Continued from page* 351.)

Second Day's Proceedings.

Thursday, September 15th, 1887.

The next thing on the programme was announced by the President to be "discussion on Memorial and Bill for National Forest Administration." Mr. Fernow spoke briefly on the attempts at forestry legislation in the various States, and read several bills on the subject—one prepared by the State Board of Forestry of California, another by Senator Miller, of New York, and another by the Forestry Commissioner of Colorado. The bill prepared by himself was then read by Mr. Fernow and discussed at length by the Congress, being finally adopted for recommendation to the Senate and House of Representatives at Washington, as follows:—

A Bill

For the protection and administration of the forests on the public domain.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

Designation of Forest Lands.

Section 1. All lands now owned or controlled, or which may be hereafter owned or controlled by the United States, and which are now, or shall hereafter be, devoted to forest uses, are, for the purposes of this Act, declared to be public forest lands.

Withdrawal of Forest Lands from sale.

Sec. 2. The unsurveyed public lands of the United States embracing natural forests, or which are less valuable for agricultural than for forest purposes, and all public lands returned by the public surveys as timber lands shall be, and the same are hereby, withdrawn from survey, sale, entry, or disposal under existing laws, and shall be disposed of only as provided in this Act and as Congress may hereafter prescribe.

Preventing entries upon Forest Lands.

Sec. 3. Every person applying to make an entry or filing of public lands under any law of the United States before the classification and survey of the forest lands as provided in this Act shall be made, shall file with his application an affidavit under oath, corroborated by witnesses, stating that the land applied for is not exclusively forest land, and not situated near the headwaters of any stream, and is more valuable for agricultural or mining purposes than for the timber growing thereon, and each such applicant shall state particularly his means of information and his personal knowledge of the facts to which he testifies, and upon a certificate from the Commissioner of Forestry the lands so entered may be disposed of under existing laws; and every person swearing falsely to any such affidavit shall be deemed guilty of perjury and liable to the penalties thereof; and all illegal entries of timber lands shall be absolutely void, and upon satisfactory proof, shall be subject to summary cancellation by the Commissioner of the general land office.

Instituting the office of Commissioner of Forests.

Sec. 4. There shall be in the Department of the Interior a Commissioner of Forests, who shall be appointed by the President, by and with advice and consent of the Senate, and he shall have the care, management and control of all the forest lands owned or controlled by the United States. He shall be a suitable person, versed in matters of forestry, and shall be entitled to a salary of $5,000 a year, with such allowances for assistants and expenses as will insure a proper execution of the provisions of this Act and as

Congress may from year to year provide. He shall hold his office during good behaviour, and may be removed by the President for cause, and before entering upon his duties he shall give bonds with sureties to the treasurer of the United States in the sum of $50,000, conditional, to render a true and faithful account to the treasurer, quarterly, of all moneys which shall be by him received by virtue of the said office.

Appointment of four Assistant Commissioners.

Sec. 5. The Commissioner of Forests shall appoint to himself four Assistant Commissioners, one of whom shall be a resident of the State of California, or any of the territories on the Pacific slope and well acquainted with the forest conditions of the Pacific slope; another shall be from the State of Colorado or any of the territories bordering the Rocky mountains, and well acquainted with the forest conditions of the Rocky mountains, and the third shall be from one of the States east of the 100th meridian, and well acquainted with the forest conditions there prevailing. The fourth shall be an expert in the knowledge of scientific forestry. The four Assistant Commissioners are to act as a council to the Commissioner of Forests in all matters pertaining to the administration of Government forest lands as constituted by this Act, and each shall have special charge of one division of the public forest reserves, which he shall personally inspect at least once every year. Each of the Assistant Commissioners shall receive a salary of $3,000.

Classification of Forest Lands.

Sec. 6. The forest lands on the public domain shall be arranged in three general classes, namely:—

First. Lands distant from the headwaters of important streams, covered by timber of commercial value, more valuable for forest purposes than for cultivation.

Second. Lands partially or wholly covered by timber, but suitable for homesteads, and more valuable for agricultural purposes than for timber.

Third. Mountainous and other woodlands, which, for climatic or economic or public reasons should be held permanetly as forest reserves.

Establishment of Forest Reserves.

Sec. 7. It shall be the duty of the Commissioner of Forests to examine and classify the forests and public timber lands of the United States, and to determine, subject to the approval of the Secretary of the Interior, what portions of such forests and timber

lands should be permanently retained in reservation for climatic or other economic or public reasons, and what portions may be disposed of without disadvantage to the public interests. He shall cause to be prepared connected maps or diagrams showing the approximate situation and areas of public timber lands in each State and territory, and the President shall, by proclamation, designate the permanent forest reserves, as the same shall be selected and approved as herein provided; and it shall be the duty of the Secretary of the Interior to cause exterior boundary lines thereof to be run and marked by durable monuments; and no further survey of any timber lands of the United States shall be made until the permanent reservations herein provided for are established.

Appraisement of Timber.

Sec. 8. The lands of the first and second class shall from time to time be appraised, under the direction of the Secretary of the Interior, and lists and plates thereof made; and the value of the timber shall be appraised separately from and in addition to the Government price of the land.

Disposition of Timber.

Sec. 9. The President may, from time to time, in his discretion, by proclamation, authorize the sale of such appraised timber on lands of the first class, on the stump, in aggregate quantities not exceeding 25,000 acres at any one sale.

Manner of sale of Timber.

Sec. 10. Such sales shall be made under the supervision of the Commissioner of Forests and in accordance with such regulations as the Secretary of the Interior may prescribe, and under the condition that the purchaser will comply with the regulations as to the cutting and removal of the timber prescribed and made known by the Commissioner of Forests; but no such timber shall be disposed of except to the highest bidder, upon sealed bids, by legal subdivisions of sections, at not less than the appraised price, and after due public notice as now provided by law.

Restoring Forest Lands to entry.

Sec. 11. Lands of the second class, when reported to the Secretary of the Interior by the Commissioner of Forests, with the approval of the President, shall be restored to homestead entry or sale; but a special price for the timber thereon, as appraised, shall be paid by the applicant in addition to the usual price and fees for the land.

Co-operation of other officers.

Sec. 12. The Commissioner of the general land office, Surveyors General, Registers and Receivers, and other federal officers connected with the public lands, are directed to co-operate with and assist to the extent of their power the Commissioner of Forests in the selection and classification of the public forest lands.

Further duties of Forest Commissioner.

Sec. 13. The Commissioner of Forests shall properly subdivide and arrange into divisions and districts of proper size such forest lands as shall constitute the forest reserves and forest lands remaining under his control, and shall organize a service of and appoint Inspectors and Rangers for their protection and proper administration and provide a practicable system of forestry. He shall make reasonable rules and regulations for the prevention of trespass upon said lands and for their protection and the conservation of forest growth, and he shall be empowered to sell timber from the said reservations as the local demands require and a proper forestry permits. He shall designate every year the areas which may be cut over and prescribe the conditions, manner, method and time for the cutting of the same and fix the Government rate for the stumpage on such areas, and upon the application of any resident citizen desirous to obtain his supply of wood from the Government forest reserves, suitable locations shall be designated to him. The Commissioner of Forests shall have the power to regulate pasturage and any occupancy whatever upon the forest lands. And all moneys received from the sale of timber or any other privileges he shall cover into the United States treasury.

Co-operation with State Boards.

Sec. 14. Whenever any of the States in which public forest lands are situated shall have instituted and provided for a forest commission or other forest management of the forest lands belonging to the State, it shall be in the discretion of the Commissioner of Forestry, with the approval of the Secretary of the Interior, to cooperate with such forest commission, and to allow the same to act as agents for the United States under his direction for the purposes of this Act.

Penalties for illegal cutting on Forest Reserves.

Sec. 15. If any person shall illegally cut, remove or destroy, or cause or procure to be cut, removed or destroyed, or aid, counsel or assist in cutting, removing or destroying any trees or timber upon any forest reserve of the United States, every such person shall be liable to a fine of not less than $100 and not more than

$1,000 for each such offence, to imprisonment at hard labour not exceeding one year, and to civil prosecution to recover the value of the property so unlawfully taken or destroyed.

Penalties for cutting timber on any Forest Land.

Sec. 16. It shall be unlawful to cut or remove without proper authority, or to cause or procure to be cut or removed, or to wantonly burn, injure, tap, girdle or destroy any timber on or from lands of the United States, or to export, transport, purchase or dispose of the same, or of any lumber, charcoal, pitch, turpentine, or other product manufactured therefrom ; and every person violating the provisions of this section shall be guilty of a misdemeanour and shall be fined in a sum not exceeding $1,000, and imprisoned not longer than one year ; and every person engaged in any such depredation upon timber or timber lands of the United States, whether as principal, agent, employe, carrier, mill owner, manufacturer, vendor or vendee, shall moreover be liable in an action of trespass for the full value of the timber or timber product at the place of delivery ; but nothing contained in this section shall prevent any agriculturist or minor from taking from his claim the timber necessary for domestic purposes or the support of his improvements.

And wherever there exists a right previously established by law, to cut timber on the public lands, every person or corporation exercising such right must comply with the rules and regulations prescribed by the Commissioner of Forests and approved by the Secretary of the Interior.

And a failure to comply with all the rules and regulations so prescribed and approved in regard to the manner of using and occupying the public forest lands shall constitute a misdemeanour punishable as provided in this section.

Penalties for occupancy of public lands.

Sec. 17. That it shall be unlawful for any person, firm, or corporation to knowingly erect, establish or maintain upon public lands of the United States without proper authority any saw-mill or manufactory of lumber of other timber products, or to engage or be employed in the manufacture of lumber, charcoal, pitch, or turpentine upon public lands, or to use at any such mill, manufactory, or works, any timber cut or removed from public lands ; and any person violating this section shall be liable to a fine of not less than $500 and not more than $5,000, in addition to the penalties hereinbefore prescribed ; and all mills, manufactories, and works so erected or maintained upon public lands shall be absolutely forfeited to the United States.

Penalties for transporting and handling illegally cut timber.

Sec. 18. That if any master, owner or consignee of any vessel, or any officer or agent of any railroad company, shall knowingly receive for shipment any timber, lumber, or timber product taken without authority from timber lands of the United States, with intent to transport the same to any port or place within the United States, or to export the same to any foreign country, every such master, owner, consignee, officer, agent and railroad company shall be liable to the penalties prescribed in the eleventh section of this Act, and the vessel on board which any such timber, lumber, or timber product shall be taken, transported or seized, shall be wholly forfeited to the United States.

Protection by Military force.

Sec. 19. The President is authorized to employ so much of the land and naval forces of the United States as may be necessary effectually to prevent the cutting down, removal, or other destruction of trees or timber on public forest lands, and to prevent the transportation of any such timber, and to take such other measures as may be deemed advisable for the protection of the forest lands of the United States.

Restricting quality of Forest Officers.

Sec. 20. No person who is directly or indirectly engaged in the manufacture of lumber, or timber products, or conducting any business which requires a large consumption of timber or wood, shall be qualified to serve as Commissioners of Forests under this Act, or to serve in any official capacity in connection with the public woodlands.

Repealing clause.

Sec. 21. That the Acts of June 3rd, 1878, chapters 150 and 151, and the first and second sections of the Act of June 15th, 1880, entitled "An Act relating to the public lands of the United States," and all Acts and parts of Acts inconsistent with this Act, be, and the same are hereby, repealed.

Enacting clause.

Sec. 22. This Act shall take effect on the 1st day of July next, but the President may appoint the Commissioner of Forests prior to that date, with his duties and salary to commence at that date.

Appropriation clause.

Sec. 23. For the purpose of carrying out the provisions of this Act, for the payment of salaries, travelling and other expenses the sum of $500,000 is hereby appropriated.

(*To be continued*).

ACTING ALLOWANCES.

(*a*). Can the Government of India's letter to the Accountant General, modify the provisions contained in the Pay and Acting Allowance Code?

(*b*). Section 56 and its addenda and corrigenda, No. 630, dated 17th December, 1885, rule that the minimum salary of an officiating Sub-Assistant Conservator of Forests should be Rs. 150 a month, and this rule was applicable to all the Presidencies. The Government of India's letters to the Accountant General, No. 6299 of 29th November, 1887, and No. 1231 of 31st May, 1884, rule that the minimum salary of the acting Sub-Assistants in Bombay to be Rs. 87-8, and not Rs. 150 as laid down in the Code. I therefore respectfully ask your learned readers to inform me if the claims of an acting Sub-Assistant, who acted from 17th December, 1885, to 29th November, 1887, and received his salary at Rs. 87-8-0, are admissible or otherwise?

(*c*). Section 152 of the Forest Department Code rules that no gazetted officers should draw his salary at an altered rate without a salary slip from the Accountant General. Supposing if the Accountant General misinterprets certain order for which an officer draws less than what he is entitled to, and the mistake when pointed out he does not like to correct, is there any remedy to this?

BOMBAY S.C., *29th July, 1888.* } DIFFICULTY.

(1). As regards (*a*), "Difficulty" should see from Section 2 of the Civil Pension Code that the Government of India reserves to itself the right of *changing the Rules in the Financial Department Code*, from time to time, at its discretion and of *interpreting their meaning*. Any subsequent orders of the Government of India to the Accountant General will have precedence over the Code rulings.

(2). Section 56, and with its subsequent addenda and corrigenda (No. 630, dated 17th December, 1885, rules that the minimum pay of officiating Sub-Assistant Conservators of Forests will be Rs 150. This provision has, however, been amended by Financial Department, No. 6297, dated 29th November, 1887, substituting "Probationary Sub-Assistant Conservators, Forest Department, India," for "Sub-Assistant Conservators, Forest Department." But Government of India Circular No. 13F, dated 18th June, 1888, in the Revenue and Agriculture Department (Forests), ruled that the salary of Probationary Sub-Assistant Conservators before deputation to the Forest School, and while pursuing their studies at that institution, should not exceed Rs. 100 per mensem, unless with the special sanction of the Government of India. From "Difficulty's" letter his position in the Department cannot properly be made out, nor are the conditions of his appointment to officiate in the grade of Sub-Assistants, at all explained If he has a substantive appointment, and was merely acting during the time from 17th December, 1885 to 29th November, 1887, the allowance admissible to him is regulated by Section 36 (*b*) of the Pay and Acting Allowance Code, which rules

that an officer with a substantive appointment officiating in an appointment the pay of which is not less than Rs. 100, is entitled to an acting allowance of one-fifth of the pay of the appointment. If without a substantive appointment the officiating officer in an appointment the pay of which is not less than Rs. 100, is entitled to an acting allowance of half the pay of the appointment, *vide* Section 37 (*a*). "Difficulty" should clearly forward a statement of his case, and of his position in the Department, before the question as to the claims of an acting Sub-Assistant to higher pay can be fully replied.

(3). As regards (*c*), in case of the Accountant General misinterpreting certain orders, reference may be made to the Comptroller of India Treasuries, when questions arising affect pay only, or otherwise, to the Comptroller and Auditor General, through the proper official channel, for an expression of their opinion, and this obtained, the matter may be represented to the Local Government for orders.—[ED.]

HOW TO BAFFLE MOSQUITOS.

IN the North-Western Provinces mosquito curtains are seldom used, and it may be that the annoyance from mosquitos is less here than it is in Bengal, where the use of such curtains is perhaps universal amongst the European population.

Some time ago a writer in the "Pioneer" stated, that it was now generally agreed on, that all lotions that had been tried to prevent mosquitos biting you were useless, and the most of them almost as unpleasant as the insects themselves; but that in time the system gets inured to their bites, and they were hardly felt. No doubt some change does take place, which prevents the swelling up that so often disfigures new comers to India, but still, however long one remains in India, the bites or punctures they make cause great irritation.

Ten years ago I placed a water tank on the top of my house, to work a small fountain in an aviary, after this, mosquitos swarmed in every room, the punkah did not keep them off altogether, and when it stopped they just devoured one; the irritation in the feet and ankles especially was so great, that I often got up and put them in water to try and allay it.

I used to read for an hour or so after going to bed, and when I got tired, I put the flame of the lamp down low, and went to sleep; one night just when I was commencing to read, the punkah was extra vigorously pulled, and the lamp was blown out; now thought I, it will be long before I will be able to go to sleep, and the mosquitos will annoy me greatly, but to my surprise, they did not do so; once or twice I did hear the sharp sing of one flying over me, in a kind of aimless way, but though I lay awake for over an hour I was not troubled.

The next night the lamp was not blown out, and when I reduced the light, and put it to one side, I was at once troubled with the mosquitos; this made me consider why I was not troubled the night before, and it struck me that perhaps it was owing to the light being out. I at once rose and removed the light into another room, so that the room I was in was dark, the mosquitos subsided at once. I then brought the light in again and the annoyance began. I then said to myself I have made a discovery, instead of rubbing your skin with lotions or covering yourself in mosquito curtains, all you have to do is to surround yourself with darkness and you are safe. I at once commenced to tell my friends of my discovery, but they all laughed at me, no one would believe it possible, that such a simple remedy could protect one, and no one would even try it; so I gave up trying to benefit others, and looked after myself; since then I have tested the thing over and over again, and always with satisfactory results.

Dr. Bonavia holds the opinion, that if the doors and windows are left open, the mosquitos will go out of the house at twilight, and return after they have fed and quietly rest, till the glimmer of light come in again in the morning, when they will go out and come in as before. I think there is no doubt but what some will do this, but some will remain and indulge in richer fluids than the sap of plants affords.

It is a well known device in fattening quails, to keep them in the dark, and several times during the day, to let in a little light, when the birds believing it to be their usual feeding time, eat away; the dim light in the room acts in the same way on the mosquitos, only they are in a continued twilight, and they remain active till they are gorged with blood; moonlight and the morning light getting into a room, sets the mosquitos going, keep all light out and they are quiescent.

ANGUS CAMPBELL.

THE BRANDIS PRIZE.

WITH reference to your note at the end of last month's "Forester" about the Brandis Prize, I would like to point out that we (students of 1886-87) were distinctly told by the Director and Deputy Director of the School to write about something we had seen, or on some work on which we had been engaged; hence the fact that "the only competing essay was in the form of a report," and yet for this very reason you say the prize was not awarded. At

the same time the essay was never judged, but was withdrawn, after having been pigeon-holed, for no less than seven months, in the Director's office.

The Brandis prize has now been offered for four years, has only once been competed for, and never won, and may I think very reasonably be termed a failure. Any strictly sylvicultural essay would be probably more or less plagiarised from Mr. Fernandez's Forestry.

Would it not be better under the circumstances to devote the money to increasing the amount of the miserably inadequate prizes now given at the Forest School, Dehra, and to prevent the unpleasantness of being obliged to reduce prizes by half at the very moment almost of presentation?

J. G. F. M.

* *Note.*—Our correspondent refers to an Essay sent in for the prize in 1887, not to the only one sent in 1888, which was not written by a Student of the Dehra Dún Forest School of 1886-87.

Our correspondent also omits to mention that the Essay sent up in March 1887, was then withdrawn from competition, at the writer's own request, and when subsequently after seven months he asked for the Essay to be sent up, it was duly sent up to the Inspector General of Forests, but again withdrawn from competition, at his own request in writing.

We believe that there are two chief reasons why suitable Essays have not hitherto been sent in for the Brandis Prize, the first being due to the fact that Students of the Indian Forest Schools at Dehra Dún and Poona have not been long enough engaged in practical forest work subsequently to their having left School, and the second, to want of sufficient notice being given early in the year that competing Essays should be sent in in March.

The latter difficulty will be avoided in future, by circulation of the rules in January every year to all Executive Forest officers in India, and as our Indian trained students gain practical experience in their own forests, they will have more confidence in their ability to write suitable Essays.

The amount of the prizes at the Dehra Dún Forest School is beside the question; the amount annually offered by Government being always Rs. 200, which has been supplemented by voluntary gifts by Forest officers. The latter naturally vary, having been, exclusive of prizes offered for athletics, Rs. 200 in 1887, and Rs. 80 in 1888.

The Direction of the School is clearly not responsible for this, and the advisability of prizes being given at all is open to question, as the high standard required for an honour's certificate at the Forest School is sufficient inducement for the best students to do their utmost to earn it.—[Ed.]

BAMBOOS FOR FISHING RODS.

Having been requested by the Under Secretary to the Government of India to assist in the matter of obtaining a supply of

bamboos for fishing rods for the English market, I entered into correspondence with the Conservators of several provinces, with a view to getting samples of various kinds of bamboos sent to London for inspection and trial.

Specimens of *Dendrocalamus strictus* and *Bambusa Tulda* were despatched from Burma in March last, and the reports on them have just reached me. The friend to whom they were addressed said he thought *Dendrocalamus strictus* not well suited for making split-cane rods, as though it had considerable substance, it was not straight, and had rather prominent joints. The two specimens of *Bambusa Tulda* appeared to be far better, being nearly straight, having very small knots, and being of fair substance; but unfortunately, in spite of the precautions that had been taken by Capt. Bingham to preserve them, both were worm eaten.

Messrs. Farlow reported both kinds as useless for rod making. Messrs. Hardy say—"the canes are quite valueless for fishing rod making. Compared with the mottled bamboos which are shipped to us from Calcutta, they are much less fibrous, and quite dead in their spring. The mottled bamboo, of which we will send you a specimen if desired, is we believe the best for our purpose, and we should be glad to make an arrangement for a more regular supply of a light quality." I am endeavouring to ascertain the species of the mottled Calcutta cane. I believe the mottling is due merely to the firing the canes are subjected to during the process of straightening.

Some Himalayan *ringâls* sent to London for me through the kindness of Mr. Bagshawe, have been successfully made up into jointed rods; a rod 16 feet 2 inches long is said to cast 28 yards of line. A doubt is, however, expressed as to whether they will stand hard use. A further report on the subject has been promised.

KULU,
24th July, 1888.

F. B.

FRUIT IN THE DEHRA DUN.

IN Williams' "Memoir of Dehra Dun" it is thus stated—"Of fruits, the pear, the fig, the blackberry, the lemon, and strawberry all grow wild. When cultivated, those of almost every description, whether European or not, flourish; except the peach, grape, strawberry, and mango. The humidity injures the three first, and the heat is hardly great enough for the fourth." This year I have for the first time eaten mangos grown in Dehra, and to me both the Bombay and country kinds seem every bit as good as those grown

in Saháranpur. The rains were late in coming on this season, and perhaps it is owing to this that the mangos are so good, but are they better than usual?

Fourteen years ago I got some peaches grown on the Markham Grant, Eastern Dún, that were equal to any I have got from Saháranpur; and every year great quantities of strawberries are sold in Mussoorie that are said to come from Dehra. I saw some grapes last month in the Forest School garden, but they were not much to look at or taste.

Will some of your readers let us know if Mr. Williams' statement regarding the peaches, grapes, strawberries, and mangos be correct or not; or if the want of success—if want there be—may not be due to bad gardening, and injudicious selection of sorts. By the pear that grows wild in the Dún does Mr. Williams' mean the *Pyrus communis?*

A. C.

Note.—Our experience after seven years in Dehra is that strawberries are the most reliable fruit to grow in the Dún, and succeed every year on well manured and irrigated land.

Peaches are moderately good in Dehra, but in Chakráta, at 5,500 feet, may be produced equal to the best European kinds.

Grapes are produced in Dehra in heavy bunches, but never ripen thoroughly, owing to the advent of the monsoon, and consequent increase of humidity and fall of temperature by ten to fifteen degrees before they have time to ripen.

Apricots blossom, but never form fruit in Dehra at 2,000 feet above sea level, but produce prolifically on the hills above 5,000 feet, and fine European kinds thrive at Chakráta.

The cultivated pears of Dehra from *Pyrus communis*, are only fit for cooking, and apples are only known to ripen above 5,000 feet. The wild pear is *Pyrus Pashia.*

Mangos, lichis, oranges and loquats are produced in abundance and of fair quality in Dehra, almost every year.—[Ed.]

WOOD USED FOR TEA BOXES IN CALCUTTA.

A dispute between certain Shipping Agents and Merchants in Calcutta regarding the quality of certain wood used for tea boxes was lately referred to the Director, Forest School, for decision as to the species of the wood, by Mr. Blechynden, the Secretary to the Agri-Horticultural Society of India.

The wood, which is locally called kaura, and comes from Moulmein, or Assam, resembles that of semal (*Bombax malabaricum*), but has a dark-brown but soft heartwood, which is said in Gamble's Indian Timbers not to exist in semal wood, and all the specimens in the Forest School Museum are free from such heartwood. The

wood may be that of *B. pentandra*, or some other malvaceous species.

Mr. Blechynden states that the wood, especially the darker portion of it, has a decidedly unpleasant odour. It is improbable however, that if properly dried, any Indian wood would corrode the lead coating of tea boxes, such corrosion being generally due to the use of green wood still containing sap.

Almost any wood of moderate specific gravity will do for tea boxes, provided it is hard and the grain twisted enough to hold nails, and the common mango furnishes one of the best woods for the purpose.

The School Museum does not contain all Indian woods, but chiefly those given in the numbered catalogue of Indian woods at the end of Gamble's Indian Timbers.

If Foresters all over India would kindly from time to time send to the Forest School well authenticated specimens of other woods not given in that catalogue, the collections there would be far more useful than at present, as the School Museum is apparently the only place in India where woods can be readily identified, and demands for such identification have recently arisen several times.

We may note that Gamble's book states that semal wood has no annual rings, this is not always the case however, and Mr. Angus Campbell, formerly of the Roorkee Workshops, states that semal when old has a very dark, almost black, heartwood, and that most of the semal trees from the Chandi forest, felled for well-curbs for the dam across the Ganges at Narora, had dark heartwood, which appeared strong and was hard, and used to puzzle people when planed and polished, and they were told it was the despised semal.

COPPICE SHOOTS OF *DALBERGIA PANICULATA*.

The *Dalbergia paniculata*, a moderate sized tree attaining a girth of 5 to 6 feet and height of 60 to 80 feet, is widely distributed throughout Southern and Central India, and is also found in the Sub-Himalayan tracts to the east of the Sárda river. Unlike its allies *D. sissu* and *D. latifolia*, which form dense highly coloured useful heartwoods, the whole wood is whitish-grey and soft, and abnormal in possessing narrow soft layers of parenchyma alternating with broad concentric masses of wood, so that planks cut out of old trees often fall to pieces.

Specimens of this wood have just been received at the Forest School from Mr. S. C. Moss, Sub-Assistant Conservator of Forests,

Tinnevelly, Madras, which show coppice shoots springing from the zones of soft tissue between two of the concentric layers of the wood; in one specimen the shoots are from close to the centre of the stem.

The stumps were 12 inches in radius, and the concentric rings vary from half an inch to a whole inch in thickness.

In the case of the shoots springing from near the centre of the stem, the latter appears to have been decomposed at the centre, and the shoot, which may have originated in a layer of soft tissue, has passed radially across three zones of harder and two of softer tissue.

This discovery of Mr. Moss' appears to be a new one in vegetable physiology, as adventitious shoots generally spring from the cambium zone, or directly between the wood and the bark.

BEDDOME'S FLORA SYLVATICA.

CAN you or any of your readers tell me where I can get a copy of Beddome's "Flora Sylvatica of Madras?" I have written to all the best publishers in India, with the invariable reply that the work is out of print, and "there is no chance of a second edition being brought out."

As this book is the only work on our Madras Flora, it surely would be worth while bringing out another edition, though perhaps a cheaper one, as the last cost nearly Rs. 60 for the whole work, considerably beyond the means of most Forest Subordinates. Dr. Brandis' Forest Flora is almost useless in Madras, and Mr. Gamble's Manual of Timbers is simply what it professes to be, and consequently gives little or no description of trees, and of course none of shrubs, climbers or herbs.

OLD FINCHLEIAN.

Note.—Surely Colonel Beddome's valuable book is in some of the Forest Divisional Libraries in Madras, and thus available for Madras Forest officers.—[ED.]

JJ. Reviews.

PROFESSOR WALLACE AND INDIAN FORESTRY.*

Although the title of Professor Wallace's new book on Indian Agriculture is somewhat too general, reminding one of Sir Richard Temple's "India in 1885," yet we can pass that over, for the excellent manner in which it is got up, with three good maps, numerous original photographs of cattle, horses and implements by the author, engravings reduced from Duthie and Fuller's "Field and Garden Crops," Duthie's "Fodder Grasses," and two chromo-lithographs of mangos.

We cannot now attempt any criticism of the agricultural part of the book, except to note that the author's remarks on the advantages of a black skin in a hot climate have attracted the attention of Professor Hornley, whilst he appears to deserve full credit for the discovery of the bad influence of early castration on animals.

Our author is very sound on the silver question, and considers that nothing but an almost impossible increase in the world's supply of gold, or the adoption by the leading nations in Europe of the system of bimetallic currency, will save the Indian Government from its present financial difficulties.

He also admits that the Uncovenanted Service lose fully 33 per cent. of the sterling value of their home pensions, and urges redress of this injustice on the Government, in the best interests of India. One of his strongest arguments in favor of restoring the relative value of silver as compared with gold is that, it would allow much unemployed British capital to be invested in India, where the present high rate, 7 and 8 per cent. of interest, checks youthful trade enterprizes in all descriptions.

When we turn to Chapter XXIV. dealing with Forestry, we regret that our author should not have studied the question from all sides, before venturing on the strong opinions he sets forth. This Chapter only covers 13 pages, out of a total number of 345, and might have been left out with advantage in a book otherwise apparently carefully written and liberally published.

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*"India in 1887," as seen by Robert Wallace, Professor of Agriculture and Rural Economy in the University of Edinburgh.

With Plates and other Illustrations. Edinburgh: Oliver and Boyd, Tweeddale Court. Calcutta: Thacker, Spink and Co.

Professor Wallace gives a map showing his journeys, which appear to coincide with the main lines of railway, and on the same map, he has marked the temperate and tropical forests of India. We find, however, that the red track of our author's journeys only pass thrice through the green wash of forests as plotted by himself, twice through the Ghâts' forests between Nasik and Bombay and Poona and Bombay, and once on the Siligori-Darjeeling Railway. When therefore he claims having had exceptional opportunities of seeing how the forest regulations pressed unnecessarily upon the people, we can only conclude that he passed through the Bombay Ghât forests at the time of the famous Thana Commission, the results of which showed that the only *well founded* complaints of the people were that, they were not allowed to reap the rich harvest of supplying the city of Bombay with forest produce from the Government forests, free of all charges, at the expense of the Indian public.

Our author was in India from the 10th May to the 13th of September, and for such a four months' traveller, who by his own admission had seen next to nothing of the Indian forests, to write authoritatively about them, two conditions are essential.

These are, first, a preliminary knowledge of the science of forestry, and secondly, a careful gleaning of facts from experienced and impartial Indian officials.

We hope to prove in the interests of Indian Forestry, and from the Professor's own words that, he can never have studied forestry, whilst we do not find any admission in the book before us that, during his stay in India, he ascertained what Forest officers had to say in support of their views, which he condemns as inimical to the future progress of India.

There can however be no doubt as to the origin of the strong opinions of the Professor, when we mention the names of the talented Directors of Agriculture in Bombay and the North-West Provinces, of Mr. Ozanne, who advocates the extension of sheep grazing, led by a few strong goats, to all our forests, and of Colonel Pitcher, whose views as to the advantages of forest fires are well known to some of our readers.

That Professor Wallace knows little or nothing about forestry the following considerations will place beyond doubt. Whilst praising the minutiæ of detail and the thoroughness of the German School of Forestry, he considers it too elaborate for the requirements of India, and not altogether in the right direction, though he might speak in the same terms of Professor Sach's Vegetable Physiology, or of Professor Hartig's work on the dis-

cases of plants. Either German Forestry is scientific, or it is false, and we who have studied it know how thoroughly general and truly scientific are its teachings, and that any system of practical national forestry must rest on such a basis, and cannot possibly ignore it. What does our author mean, by the *natural rotation* of European forest trees, is he, as an agriculturist, thinking of *the rotation of crops?* Why will "*a supply of timber*, however *excellent, never repay the smallest sacrifice of the interests of the present generation*," and yet why, later on, is the Professor '*far from condemning this very principle of self-denial?* Why should a forest, "*when artifically matured, long before it is cut swallow up its final sale value in expenses*"?

This doctrine would hardly go down in Scotland, where large areas of Scotch fir and larch forest are grown with considerable profit to their owners, and where our author in this very book admits the existence of '*well managed public and private forests.*'

Why are forest fires—considered public calamities in France and America—in India, "*a natural process of healthy retardation, clearing and thinning, under which all the magnificent forests of India have been nursed and reared.*"

We always thought that the only magnificent forests left in India in 1860, when Professor Wallace states that Forest Conservancy commenced, were either in the moist climates of the Ghâts, Bengal, Assam and Burma, where fires never touch the evergreen forests, or the deodar, oak and fir forests of the Himalayas, which rarely burn, whilst much of our sál and teak forests was mere scrub, and entirely devoid of healthy advance growth, owing to the devastations of the annual forest fires, from which we are now doing our best to protect them, and with such signal marks of improved growth and reproductive powers.

What magnificent forests of sál and teak and pine remained, grew up during the Gurkha dominion of the Himalayan tracts and the Mahratta wars and the cruel Burmese ravages of Assam, when men had other things to attend to besides firing the forests, and we read in Sir W. Hunter's Imperial Gazetteer that vast tracts of country fell out of cultivation, and dense forest covered the former sites of fields and villages.

The example given of the burning of *Pinus excelsa* forest in Murree in 1887, was discussed in the "Pioneer," and the splendid results of fire protection in the reproduction of this species were clearly proved.

Although we cannot agree with Professor Wallace that any benefit can result to tree growth from forest fires, we readily admit

that firing inferior scrub, and the dodder of which he complains only attacks such low forest growth, or grass-land, where the grass cannot be cut, may destroy insects and parasites and produce fresh tender herbage, and in the School Circle forests of the North-Western Provinces, all such tracts are burned annually for the benefit of the villagers, only valuable forest, or steep hill sides, being protected.

Again, "*why should Government want to grow great forests of large timber, it is of little value to the masses of the population, whose wants are supplied by saplings, poles and branches, and by the fruit and shade of such trees as they and their cattle can get access to*"? And yet, if the people really only required small timber, why does our Professor advocate the destruction of undergrowth by annual fires, and by the browsing of cattle, in order to give room for the larger trees? True forestry would keep the soil and the feet of the trees well sheltered by undergrowth and their crowns exposed to the light, but Professor Wallace thinks otherwise.

How the poles for the villagers are to be obtained from his universally burned and browsed forests, we leave the Professor to explain.

But do the natives of India merely want poles and branches, and is not the wood used in the construction of native houses in Upper India chiefly in the form of scantling, which to resist the attacks of white ants must be free from sapwood and sawn from mature trees, and millions of which are bought up annually at Delhi, Meerut, Kheri and other places in Upper India?

How about the millions of cubic feet of sál planking used annually for the boats of the Brahmaputra and Ganges rivers and their branches, in which the agriculturists chiefly depend for the export of their superfluous produce? We leave out of all consideration the demands for railway sleepers, for timber for manufactures and furnitures, and for buildings in our towns and the large export of teak timber to Europe, which Professor Wallace has also entirely forgotten in his Chapter on Indian Forestry.

Whilst he would give up the valuable State forests to wholesale grazing and fires, for the benefit of the comparatively few villages, which are sufficiently near them to use the forests, Professor Wallace entirely ignores the wants of the vast masses of the agricultural population living remote from the forests, in which their cattle cannot graze, and who may fairly demand from the State that forests may be kept up for their wants in agricultural implements, fuel and building material, and for the various demands of a rapidly increasing population.

One of the most urgent calls on Government, and which it has

thoroughly recognized, is for improved sanitation and better house accommodation, especially for the fever stricken population of the Doab, and yet Professor Wallace in his advocacy of curtailing the present limited State forest area, would render impossible a supply of cheap timber, that indispensable element of improved houses.

We think that we have said enough to show that Professor Wallace's conclusion that our department is living like "*a parasite on that of agriculture*" is not founded on proper premises, and we are quite ready for the enquiry which he urges on Government as to the way in which rigid forest protection is injurious to agriculture, and consequently to the country at large, and regarding its influence on the growth of the timber supply of the future.

With wholesale browsing and annual firing of our forests sanctioned by Government, we wonder what purpose could be served by raising the Forest School of Dehra Dún to a higher status and greater proficiency, which our author advocates, or what would be the good of a Forest School at Edinburgh, where the Professor could hardly expect the proprietors of the neighbouring well-managed private forests to allow him to test his theories of fires and browsing, which, if good for India, must surely also be good for Scotland.

If only Professor Wallace could have found time to consult some of our leading foresters, Mr. Shuttleworth at Poona, or Mr. Ribbentrop at Simla, and had he not been completely swayed by his agricultural friends, his chapter on Forestry might have been as useful as those on cattle breeding, or on cereal crops. We can see the true instinct of a North Briton who really delights in forests, and in tree planting, shining like a sun through the clouds of prejudice, in the following sentences :—

"It is quite sad to look upon the bare hills and barren plains where report says extensive forests were recently in existence. I came across quite a number of such places. The naked hills in the Simla district bear testimony to my remarks. The surroundings of the mountain capital of India would have borne a very different aspect had Government taken the advice of the present Marquis of Tweeddale—at that time Lord William Hay, Commissioner of Simla—and preserved all the forest around within a radius of 10 miles. It is only fair to draw attention to the fact, that the spoilation of valuable timber was not the work of the ryot or cultivator for local purposes, but the work of contractors employed in supplying extraneous demands.

"However much the existence of forests may affect the rainfall in other countries, I do not believe that, if even the limits of afforestation had been reached, that the amount of rain in India would be materially increased or appreciably altered in any way. The influences which affect the

rainfall of India are of too great magnitude to be easily affected by local circumstances; but the primary function of a forest in India is the retention and distribution of the rain or moisture. Trees act as a natural covering to the soil into which the rain sinks, in place of accumulating and running off by surface drainage. On steep hill sides the denudation is carried on with great force by the sudden accumulations of water, which breaks the surface and tears up soil as it descends, and finally deposits a mass of débris on some alluvial track below in a rough and valueless condition."

FORESTRY IN THE CAPE COLONY.*

We presume, in the absence of his signature, that the introduction to this report is by the Compte de Vasselôt, who is still we believe Superintendent of Woods and Forests in the Cape Colony, and the remainder of the report is by the three Conservators—Mr. J. Stow Lister of the Western Forest Division, dated Tokai, 6th April, 1887; Captain Harrison, Conservator of Forests, Knysva; and Mr. D. Hutchins, Conservator of Forests, Eastern Division.

There are also annexures to these reports by Divisional Forest officers.

These would appear to be hardly necessary in a report of an important Colony, where the Conservators could surely embody all that need be said in their own annual reports, especially as in every case they are very short, that for the Conservator of Forests, Knysva, only occupying one page.

The Superintendent's remarks are arranged in three heads:—

(i). Preservation of forests.
(ii). Utilization of forest produce.
(iii). Plantations and replanting.

Under the first heading he insists on the necessity of a good forest law, a draft of which he has submitted to Government.

In Knysva, it appears that, much forest has been lost to Government by reckless admission of rights, whilst two lots of Crown land were alienated without the existence of forest on them being reported to Government.

The draft forest law provided for the cancellation of such rules in future, and also for the *inalienability* and *imprescriptability* of Crown forests and the prevention of destructive fellings in them. Mr. Hutchins has stigmatised the revenue obtained from such fellings as 'not the legitimate yield of the forests, but a fraction of the money yielded by the destruction of the forests,' and we

* Report of the Superintendent of Woods and Forests, for the year 1886. Cape Town, published by W. A. Richards and Sons, Government Printers, Castle Street, 1887.

sympathise most cordially with the Superintendent in his wish to prevent such destruction by law.

He also proposes to compel proprietors of land adjoining Government forests to take precautions that fires kindled for renewing pasturage should not spread to the forests.

Under the second heading we read that, the Knysva forests have yielded 90,000 cubic feet of yellow-wood in railway sleepers, and that this yield can now be continued in *perpetuo*, whilst formerly only 18,000 feet were cut per annum, and this whilst the forests were being exhausted by bad treatment, the wood cutters choosing trees of average age for convenience, instead of those fully mature.

The Crown forests of Knysva, without counting stink-wood, or wagon-wood required for colonial industries, could yield annually sufficient wood of different species for 100,000 sleepers, whilst 50,000 more might be obtained from private forests.

Under Plantations, we read that convict labour may be profitably employed on this work, and that the nursery at Tokai has yielded 1,000,000 plants, 123,500 of which have been given away, and 275,000 planted out departmentally.

On the Cape Flats, 470 acres have been most successfully planted out by Mr. Lister.

Mr. Hutchins has demarcated half the forests in the Division of King Williamstown, and they are being enclosed in wire fences, costing £17 8*s*. per mile, with four wires to keep out cattle, or £5 17*s*. more with two additional wires to keep out sheep and goats, as well.

The blue gum tree grows well at Worcester, and proves that judicious plantations are a profitable investment in the Colony, where many of the Divisions are sadly in want of wood, so that the question of re-afforesting on a large scale will be brought prominently forward.

The Introduction terminates with two statements of the imports and exports of timber from 1882 to 1886.

The value of the imports has steadily decreased from £235,367 in 1882 to £41,459 in 1886, whilst the exports have remained about constant, and were valued at £902 in 1886, together with £200 for other forest produce.

The chief exports in 1886 were 7,475 cubic feet of boxwood. In Mr. Lister's report on the forests of the Western Division, we read that considerable sowings and plantings, chiefly of pines, Australian wattles and eucalypts were carried out. On the mountain sides at Tokai, *Pinus insignis*, *Cupressus macrocarpa*, and *Pinus canariensis* thrive best. On the Table mountain, *Pinus sylvatica*

does well, whilst on the Cape flats and downs large areas have been planted with *Acqcia saligna*, one acre of which, nine years old, yielded £28 worth of bark, and fuel worth £20; we are not informed what this plantation cost.

Mr. Lister employed 150 convicts and 50 free men in exterminating the *Phylloxera vastatrix*, which had attacked certain vineyards at the Capé, whilst a quantity of American vine, which is reported to withstand its ravages, is being sown for distribution.

There is little in Captain Harrison's report, which is supplemented by Messrs. Rawbone, Fourcade and Cooper, his assistants, and deals chiefly with timber works for the gold fields and railways. Much fuel is being sold, for which it is calculated that every ton of quartz crushed requires 8 cubic feet of timber.

Mr. Hutchins' report concludes the paper, and amongst other matters of purely local interest, we read that, the wood of the Umzumbeet (*Milletia Kafra*) is found superior to *Lignum Vitæ* hitherto used for the bearings of diamond cutting machinery, whilst the Cape box (*Buxus MacOwanis*) of the Coast forests, finds a ready sale in London. It is named after Professor MacOwan, the Government Botanist of Cape Town. Game is being preserved in the Government forests, the former large drives by natives, in which every thing living was slaughtered, having been stopped, and attempts to introduce trout are being made, *Salmo fario Ansonii*, which has succeeded well in Australia to be first tried.

Mr. Hutchins states that Australian Jarrah seed costs only 1*s.* per ounce, and is cheaper than sneeze-wood seed, whilst the Jarrah grows faster than sneeze-wood, and Australian gums and wattles thrive on the east coast of the Colony with a dry warm winter and damp semi-tropical summer.

The stone pine has failed here, whilst *Quercus Suber* and *Castanea vesca* are being propagated successfully and *Buxus sempervirens* from layers.

We also read that in the Cathcart mountains some deodars from Grahamstown have been planted and are growing vigorously.

There is no general financial statement for the Cape Forests, but it is evident from the report before us that much useful work is being done.

FORESTRY IN THE STRAITS SETTLEMENTS.*

THE Forest Reserves in the Straits Settlements are of the following classes :—

* Annual Report on the Forest Department in the Straits Settlements for the year 1886, by N. Cantley, F.L.S.

Reserves for supply of fuel and small building material to the towns.

Coast reserves for fuel.

Reserves for protection of streams, mountain crests and for yield of timber.

The total area of the reserves is as follows :—

	Acres.		Under timber, Acres.
Singapore,... ...	... 11,544	of which	6,212
Malacca, ...	... 22,321	„	15,700
Penang, ...	... 8,833	„	5,415
Total,	... 42,698	„	27,327

It is also stated that about 29,000 acres of forest land remain to be demarcated in Malacca, which will bring up the reserved area to $\frac{1}{10}$th of that of the Settlement.

It would be interesting to know what proportion of the area of Penang and Singapore has been reserved.

We read that all the reserves have been demarcated by eight feet paths, and most of them have been surveyed, so that the permanency of their reservation for the public may now be considered as secure.

There are only a few private rights within the reserves, these consist of holdings, which are to be purchased in Singapore, but in the other States we read that, several Malay families possess rights to remove fruit and small timber over restricted areas, and Mr. Cantley does not suggest how these rights are to be provided for, or disposed of.

Long forest experience in other countries has proved the necessity of settling such questions on an equitable basis, with the least possible delay, as the value of prescriptive rights is apt to increase considerably with the progress of civilization.

Regular beats for Forest guards have been established, each man in Singapore having 577 acres to protect, and 3 miles of boundary to keep in order and 2 miles of water frontage requiring patrol in a boat. In Malacca the average charge is 2,232 acres. In Penang the extent of the beats is not given.

Several arrests for forest offences were made, and fines to the extent of Rs. 261 inflicted by the Magistrates.

The fire lines in Singapore kept out nearly all external fires, which raged everywhere throughout the open country.

In Penang the reserves were completely protected, but we see

nothing recorded on the subject of fire protection as regards Malacca.

The results of the few years' protection of natural reproduction is most encouraging, seedlings appearing where there were no traces of them before.

A good deal of planting was undertaken in Singapore of miscellaneous species, such as teak, mahogany, casuarina, eng, *Lagerstræmia* and others, and the cost was Rs. 20 per acre, including nursery charges.

Little is said to be required in Malacca beyond the introduction of *Gutta Percha* and other trees yielding valuable products into reserves, from whence timber could only with difficulty be exported.

Mahogany is said to do well in Malacca. All scientific botanic work has been entrusted to the Forest Department, the herbarium, economic garden, &c. In Penang, the nurseries are at different altitudes, one in the plain, one at 1,900 feet, and one at 2,550 feet elevation respectively.

At 1,900 feet, figs, peaches, olives and oranges thrive, and apple trees have borne fruit. Mr. Cantley very rightly remarks that a simple Forest Ordinance is required, and that it is but fair to the public and to the Forest Department that clear and simple rules for guidance should be authorised by law.

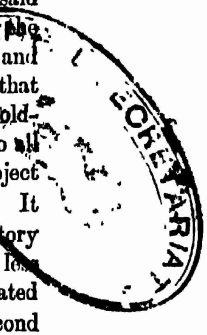
We agree with Mr. Cantley that forest conservancy has now been firmly established in the Straits, and it remains for the Department, if possible, to make itself self-supporting by taking pecuniary credit for the timber and produce supplied to other Government Departments.

We look forward shortly to the preparation of Working Plans to secure the sustained yield and improvement of the forests, and we append the following summary of a good year's work, which has been very clearly described in the report before us :—

"Area demarcated, 16,117 acres; length of boundary line opened, 100 miles; maintained of previous years' demarcation, 95 miles; total length of boundary and coast line now under protection, 254 miles; area protected, 42,708 acres; average per watchman employed, 1,256 acres; cost of protection per acre, 6 cents; area planted, 38 acres; area weeded, 104 acres; cost of planting per acre, $20; number of plants propagated about 100,000; planted, 65,000; herbarium specimens collected, 3,000; quantity of seed collected, 200 lbs.; number of kinds of seeds received, 250; number of prosecutions, 18; convictions, 16; amount of fines imposed, $281."

III. Notes, Queries and Extracts.

The Timber Acts (Ireland) Amendment Bill.—In the House of Lords on Monday last the Earl Cadogan moved the second reading of the Timber Acts (Ireland) Amendment Bill, and said that its object was to embody all the Acts passed since 1783 for the encouragement of the planting of trees in Ireland in one Act, and to extend the benefits of those Acts to statutory tenants in that country. By the Act of 1783 it was enacted that persons holding leases for lives renewable for ever should have a right to all trees planted by them, and subsequent Acts on the same subject had extended the right to tenants holding for lesser terms. It was now proposed to extend the benefits of those Acts to statutory tenants in Ireland and to those holding under leases of not less than 31 years. A memorandum of the Bill had been circulated stating its objects and its effect. He begged to move the second reading of the Bill.



The Marquis of Waterford was afraid that the memorandum of the Bill which had been circulated was not quite accurate. He thought that it was most undesirable to embody in such a measure as this a number of Acts of Parliament which had been passed in the last century, the effect of which it would puzzle even a lawyer to ascertain. It might some day be discovered that some of those Acts contained germs of a very formidable character. He suggested that instead of those Acts being embodied in the present measure the Bill should only embody in it the Act of 1783. (Hear, hear.)

Lord Inchiquin did not think that there was much harm in the Bill, and certainly, if the memorandum were accurate, there could not be much objection to it. He suggested that all the former Acts dealing with the subject should be repealed, and a simple measure introduced for the purpose of carrying out the objects now sought to be attained. He thought that the best course to adopt would be for the noble lord to consent to recast his Bill.

Lord Fitzgerald agreed that it was wholly unnecessary to incorporate all the different Acts on the subject in this Bill, which would merely lead to confusion. In consideration of the difficulty

of the points raised, he had intended to suggest that the Committee stage of the measure should be postponed until after Whitsuntide. If this Bill passed, the rights given should be surrounded with sufficient safeguards. He could not, however, avoid expressing the opinion that legislation of this kind always terminated in paring off some right of the landlords.

The Marquis of Salisbury said that the noble and learned lord had expressed such admirable sentiments as to the attempt to pare down the rights of the landlords, that he could only regret that he was not equally sensitive on the subject when matters far different from the value of oak trees were under discussion.

Lord Fitzgerald—I was not in the House.

The Marquis of Salisbury said that was another cause of regret. During the course of the debate it had appeared that the actual bearings of the Bill were not thoroughly understood, and it had excited considerable disquietude in the minds of many of his noble friends behind him. It would, therefore, be reasonable to put off Committee on the Bill until after Whitsuntide, which would, he hoped, allow sufficient time for the examination of the Bill, and enable noble lords to ascertain that it was a harmless measure.

The Lord Chancellor wished to say that no new rights were conferred by the Bill. The new right created was simply the right which existed under the Timber Acts now in force.

After a few words from Earl Cadogan, the Bill was read a second time.—*Timber Trades Journal.*

PIGEONS HATCHING OUT A CHICKEN.

My son, wanting some pigeons' eggs to put in his collection, took two eggs from under one of his pigeons; afterwards thinking that the pigeons seemed very miserable, he put into the nest the egg of a Brahma fowl; 19 days afterwards the chick was hatched, and the pigeons were very much astonished when the chick got out of the nest and ran about, it was a strong healthy bird, and is now going about with a batch brought out by a hen; and is doing well.

A knowledge that this can be done might be of use to a person who has pigeons, and hen's eggs, that he would like hatched, but has not at the time a hen ready.

A. C.

BY ORDER OF THE LIEUTENANT GOVERNOR OF BENGAL. FORWARDED

THE

INDIAN FORESTER.

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THE PROPOSED SCHOOL OF FORESTRY AT EDINBURGH.*

My friend, Dr. Hugh Cleghorn, your late President, has done me the great honour of suggesting that I should deliver an address to the members of the Royal Scottish Arboricultural Society at this year's annual meeting. Unfortunately, I am unable to be present, and I therefore thankfully avail myself of my friend's offer, to read at the meeting a few words which I desire to address to the Society. First of all, I wish to express the great satisfaction which my position as an honorary member of the Royal Scottish Arboricultural Society affords me. This great honour was conferred upon me fifteen years ago, while I was holding the position of Inspector General of Forests to the Government of India. At that time it was very gratifying, and I may truly say, it was a source of great comfort, under circumstances which were unusually difficult and by no means always pleasant, to find that my labours in the cause of Forestry were appreciated and recognised by the foresters of Scotland.

I have said that the circumstances under which I worked in India were difficult. You are all aware that India has a civilisation much older than the greater part of Europe; that, while our ancestors, two thousand years ago, were leading a roaming life in the woods, living upon the game they caught, without fields and fixed habitations, a large portion of India was, and had long been, an open, highly cultivated country, governed by powerful kings, with large cities, temples, and palaces, the inhabitants of which had

* By Sir D. Brandis, K.C.I.E., late Inspector General of Forests to the Government of India. Reprinted from the "Proceedings of the Royal Scottish Arboricultural Society," July 1887.

an elaborate system of laws, a system of religion, and a literature rich in poetry. You are also aware that the civilisation of the West, although it commenced at a much later period, has in most respects overtaken and far outrun the ancient civilisation of the East.

When, about thirty years ago, we commenced to take action, in a methodical manner, to place the management of forests in India upon a satisfactory footing, we were confronted with difficulties of a peculiar kind. You have all been accustomed in Scotland, from your early youth, to regard the proprietary rights in waste and forest to be as clear and settled as the proprietary rights in fields and gardens. The boundaries of estates over heath and moorland are as well defined as where they run between farms and houses. In India, on the other hand, the proprietary rights in forest and waste-land had not developed to the same extent as the rights in the cultivated area. In most parts of the country, whether the rulers were Hindus, Buddhists, or Muhammadans, the prevailing idea was that the forest and waste belonged to the ruling power. This idea, however, was by no means general. In some provinces, noblemen and other large proprietors had, in course of time, appropriated all the waste-land and forest; and in other districts, where the system of village communities had become fully developed, the waste and forest, and sometimes a part of the cultivated lands also, were regarded as the joint property of the village community. Hence there was in many cases great uncertainty regarding the first and fundamental question, who is the proprietor of the forests? And the difficulty was increased by the existence of what are called "rights of user" in the forests—*viz.*, the rights which the inhabitants of the neighbouring villages had exercised from time immemorial to cut firewood and timber, to collect grass and other forest produce, and to graze their cattle in the forests. Similar rights of user, as you are all aware, are found, not only in India, but in many forest lands of Europe. In the New Forest, for instance, the largest of the British Crown forests, the Crown has unrestricted proprietary rights in a small part of the area, while of the remainder a portion only may at one time be enclosed and planted, the same being thrown open to pasture and the exercise of other rights by the commoners when another area is enclosed.

The British Government in India, as the guardian of public interests, could not any longer delay action in the matter. It had become apparent to all thoughtful observers that the long period of peace and quiet, brought about by the consolidation of the British power in India, had stimulated the process of clearing the for-

ests for cultivation, so that everywhere forest was disappearing to make room for fields. This steady increase of cultivation was the necessary consequence of the just and good government which India had enjoyed under British rule. At the same time, the consumption of timber was augmented, and the destruction of the forests was intensified by the construction of railways, the building of roads, bridges, and canals; by the erection of public buildings throughout the country, the growth of the export trade and of manufacturing industries, and by the steadily increasing well-being of all classes. Where the forests had not been cleared to make way for the plough, most, and in many places all, accessible timber fit to be used was cut and brought away, to be consumed as fuel and charcoal, to be used for shipbuilding, for railway sleepers, or for house-building. The gradual disappearance of the forests, and the deterioration of those which remained, became alarming, and it began gradually to be acknowledged that action must be taken in the matter. The Indian forest question had been brought before the British Association for the advancement of Science, at the Edinburgh meeting of 1850, and a committee had been appointed by that meeting to study the question, and to submit a report. Of the members of that Committee, two are still alive—your late President, Dr. Hugh Cleghorn, and General (then Captain) Richard Strachey, the distinguished President of the Royal Geographical Society, who, while Secretary to the Government of India, has done more than any one to pave the way for a good organisation of the forest business. Upon Dr. Cleghorn devolved the duty of writing the Report, which was submitted to the meeting of the British Association in 1851.

Previous to this, action had commenced in India in different places. In 1842, Mr. Conolly, the Collector of the district, commenced the magnificent teak plantations of Nilambur in Malabar, which for many years were in charge of a valued member of your Society, John Ferguson, of whose death last year I was grieved to hear. In 1847, General (then Captain) Frederick Cotton drew the attention of the Government of Madras to the Anamalai teak forests, and on his recommendation Lieutenant (now General) James Michael, Companion of the Star of India and an honorary member of your Society, was appointed, in 1848, to conduct the timber operations in those forests. About the same time Dr. Cleghorn, then Civil Surgeon of Shimoga in Mysore, had represented to the civil authorities of that State the evils resulting from the wholesale destruction of the forests through the shifting *kumri* cultivation, by cutting and burning the forest, and it was mainly

of Forests. The measures to protect the forests against these annual fires form an important and often very difficult part of a Forest officer's duty in most provinces of India. This work, which during the hot season is extremely laborious and trying to health, is happily not needed in Scotland. Again, in the drier districts of India one of the chief aims of forest management is to increase the supply of fodder for cattle, particularly during seasons of drought. But time presses: I must be satisfied with a bare mention of this most important feature of Indian Forestry, and must give up the idea of entering further into this branch of the subject.

The main point of difference between the work of a forester in Scotland and that of a Forest officer in India, consists in the vast area of the Indian forests, and in the magnitude of the operations involved in the management of these estates. You are aware that those forests in the British Indian Empire, which are the property of the State, and which have been either freed of customary rights of user, or in which these rights have been defined and settled, are called "reserved State forests." There are other forests, over which the Government exercises a certain control, more or less effective according to circumstances, but on the present occasion I shall limit myself to the reserved forests. Well, their area, according to official documents, on the 1st April, 1885, amounted to nearly 50,000 square miles, or 32 millions of acres, all the property of Government, and managed by Government officers. You will at once understand that for the protection and management of so large an area, a very large staff of officers, numbering many thousands, are employed, and that nearly the whole of these are and must as a matter of course be Natives of India. Among these again there are, as you can readily imagine, superior and subordinate officers, and in order to give candidates for the superior Native forest service the needful professional education, a Forest School was established in 1878 at Dehra Dún in Northern India. Of this Forest School I am glad to see you have in the last volume of your "Transactions" an excellent account by Colonel F. Bailey of the Royal Engineers, who, after having organised the Indian Forest Survey, became the first Director of the School, and Conservator of the extensive forests attached to it for the practical instruction of the students. At this school, my former colleagues tell me, there are now about 60 young men from all parts of British India, Hindus, Muhammadans, Buddhists from Burma, and Native Christians. Only a comparatively small number of the highest appointments are filled by men sent out an-

nually by Her Majesty's Secretary of State for India. The number of these appointments is, I am informed, now about 170, and it is not intended considerably to increase it. Although these officers sent out from home are on arrival in India, in the first instance employed in subordinate positions, yet when they have become familiar with the language and the peculiar work in India, they are destined to fill the highest appointments. Hence a most important part of their work consists in directing a large staff of subordinate officers. From among them are selected the chief Forest officers in the different provinces, the officers charged with the preparation of working plans, and the Professors of the Forest School. With them rests, and must generally rest, the initiative in professional matters, and any mistakes made by them may have a far reaching and very mischievous effect. You will readily understand that they ought to be picked men, thoroughly familiar with the science and practice of forest management in Europe, and with the experience gained in forest administration in those countries, where it is best understood, and where it exists on a large scale analogous to what we find in India.

Now I will direct your attention to the manner in which forest business is managed on the Continent of Europe. In the kingdom of Prussia, for instance, the area of the State forests alone amounts to 6,600,000 acres. More than twice this area is in the hands of towns, villages, public corporations, and private individuals. The whole of the large forest area of Prussia,—upwards of 22,000,000 acres,—is managed on a regular system, with the object of maintaining a uniform annual yield in wood, timber, and other forest produce, the amount of which over a large portion of the area is slowly increasing every year, as the result of the steady improvement which takes place in the condition, and, consequently, in the productive powers of the forests. The number of the superior officers entrusted with the management of the Prussian State Forests is 807. As regards their duties, they correspond in India to the superior Native staff, who receive their professional education at Dehra Dún, and the staff recruited by the officers whom the Secretary of State for India sends out. The professional education of the superior Prussian Forest officers is organized thus: After passing the closing examination at one of the large German public schools, the candidates go through a practical apprenticeship of one year in one of the State forest districts, and after studying for two years at a forest school, and one year at a university, they may present themselves for their first examination, which, like all others for State service in Prussia, is a pass, and not a competitive examina-

tion. A high standard is fixed, which must be attained. The next step is to spend two years in practical work in several forest districts, after completing which the candidate presents himself for his second or final examination, which, like the first, includes all branches of forestry, the questions asked having, however, more special reference to the actual requirements of the service, than was the case at the first examination. The closing examination at the public school is generally passed at the age of 19, so that, allowing one year for military service, and six months for the two examinations and the unavoidable delay connected therewith, the candidate will have attained the age of 26 or 27 by the time he has passed the final examination. He then receives the designation of *Forst Assessor*, and is eligible for employment in the State forest service. Government, however, is in no way obliged to find employment for passed candidates, and as a matter of fact, few obtain a permanent appointment in the lowest grade of the superior Staff, which is that of Oberförster, before they are considerably past the age of 30, while those who do not find such employment seek appointments in forests belonging to towns and villages, to public corporations, or private proprietors. In other German States the arrangements are similar to those just described. There are local peculiarities, but the principle is the same; everywhere a thorough and prolonged professional training, partly practical, partly theoretical, is required of candidates for the superior State forest service.

I do not apologise for claiming your attention so long for the organisation of the Forest Service in Germany. You will presently see that it has a direct bearing upon subjects in which you are specially interested. My experience has taught me, that young Englishmen, Scotsmen, or Irishmen are, by constitution and habits, admirably fitted to make first-rate Forest officers. Nevertheless, on the first occasion, when I had an opportunity of carrying the point, which I long had in view, I requested the Government to permit me to select two German Forest officers for service in India, who had passed all examinations for the superior State forest service. This was in 1866. I took the greatest possible pains in this business, was favoured by circumstances, and was most fortunate in my selection. What I wanted were men as young as possible, who had successfully passed the prescribed course of professional training similar to that which I have just described to you. It thus happened that they were not Prussians. Dr. Schlich, who succeeded me as Inspector General of Forests when I left India in 1883, was a native of Hesse Darmstadt; and Mr. Ribbentrop, who is now act-

ing in the same appointment while Dr. Schlich is employed at Cooper's Hill in starting the Forest School, at which, as you are aware, candidates for the Indian Forest Department are now educated, was a native of the former kingdom of Hanover, which in 1866 had just been annexed to Prussia. The fact that the Government of India have selected these two men for the important appointments which they now hold, and that for these appointments they have been preferred to many Forest officers in India of great ability and experience, shows, that the thorough professional training which Dr. Schlich and Mr. Ribbentrop had received in their own country, had been most useful to them in India, and that its value has been fully recognised by Government. It is, as you may readily imagine, a source of great satisfaction to state these facts to you, and I venture to hope, that some day it will be carefully considered, whether those Indian Forest officers, who are destined for the highest appointments in that country, ought not to receive a professional education as thorough as the candidates destined for the superior staff of the Prussian forest service. The time allotted to their studies at Cooper's Hill is two years, while the time allotted to their professional studies under former arrangements on the Continent of Europe was two years and eight months only. The time was not fixed so short because that was considered as sufficient, but because it was and is not, I believe, at present deemed possible to assign a longer period or to organise the whole business in a different manner. The professional education of Forest officers in Germany has not always been as elaborate and as prolonged as it is at present. In every country these are matters of gradual growth.

But good and really effective forest management is of vital importance for the welfare of the people of India. We, all of us, who had anything to do with the growth of forestry in that country, started with the provision of a lasting and, if possible, steadily-increasing supply of timber, wood, bark, and other forest produce as the aim and object of forest management, and, in addition, we hoped that by improving the forests on the hills the water-supply for irrigation would be better regulated, that inundations and the silting up of rivers would be diminished, and the like. At a later period experience taught us that in certain parts of India, the sufferings caused by drought and famine might be somewhat mitigated by increasing the production of cattle fodder in the forests. And within the last few months it has been established beyond doubt, that in the Central Provinces the protection of the forests has already had an appreciable influence upon the rainfall. This had long been hoped for by enthusiastic foresters in India, but

there was no proof for it. This proof has now been obtained, and I may add that I owe this most important information to the highest living authority on the subject,—to my friend, Mr. H. F. Blanford, the Meteorological Reporter to the Government of India. Deficient rainfall means famine in India, and we may therefore hope that the improvement of forests on a sufficiently large scale in certain parts of the country will to some extent tend to diminish the risk of drought and famine.

You will readily understand that with these important interests at stake, every effort ought to be made to steadily improve the professional training of the Forest officers sent out to India from Great Britain. I shall not enter further into this subject, which, though of paramount importance to India, is not of such special interest for the members of your Society. But what I desire to say is this, that the requirements of wood-managers and foresters in Scotland are entirely different from the requirements of Indian Forest officers. It does not follow that in special cases, foresters, who in Scotland have learnt their profession in the empirical manner hitherto customary, could not work their way up to the higher ranks of the Indian Forest Service. There have been many instances in India which show that under the guidance of good officers, and otherwise under favourable circumstances, men can make up, by means of industrious study, and of steady hard work, for their deficient professional education at the outset. Indeed, as explained to you in Colonel Bailey's excellent paper on the Indian Forest School, to which I have already adverted, the bulk of the work in the first organisation of Indian forest business was successfully accomplished by men who had not received any special professional training. This, however, was in the beginning, when forest work in India had more of an administrative than of a professional character.

As further progress is made, this will change, and new problems of a professional character will present themselves, which will tax to the utmost the special knowledge and the skill of the forester in India.

My advice in this matter is, to keep the two undertakings entirely distinct, the elaborate professional and scientific training of those who aspire to appointments in the superior forest staff of India, and the establishment of forest schools for wood-managers and foresters in Scotland, England, and Ireland. In Prussia and other countries of the Continent of Europe, the State is the largest forest proprietor; moreover, it is justly held to be the duty of the State to watch over the good management of the forests which belong to towns, villages, and public corporations. In

these countries, therefore, it clearly is the business of the State to organise the system of forest instruction. It is different in Great Britain, where, out of a total area under timber of about 2,800,000 acres, the Crown has only about 100,000 acres, while the rest belongs to private proprietors. In the United Kingdom the condition of things is similar to that which exists in some parts of Austria, notably in Bohemia and Moravia, where the large forest proprietors have formed two Associations for the purpose of providing professional education for young men, who desire to enter their service as wood-managers or foresters. The professional education for the State forest service in Austria was considered too high and too expensive for the requirements of these private estates; the proprietors therefore determined to help themselves. The Bohemian school at Weisswasser was established in 1855; students are required to pass through a middle class school, and to serve a practical apprenticeship of twelve months, after which the course of studies at the school occupies two years, A forest district of 2,900 acres, the property of Count Waldstein Wartenberg, is attached to the school, and placed under the control of the Director for purposes of practical instruction. The Director, Chevalier Fiscali, is a distinguished forester, and under him is a staff of five professors, one for those branches of forestry not taught by the Director himself, one for mathematics and surveying, two for natural sciences, and one for drawing and book-keeping. Eulenberg, the school maintained by the Association of Forest Proprietors of Moravia and (Austrian) Silesia, was founded in 1851, and has a similar organisation. No fees are paid by sons of foresters.

Ever since I heard of the plan to establish a forest school in Scotland, I have been of opinion, and have given expression to this opinion whenever I have had and opportunity, that as soon as the desire gains ground among proprietors in Scotland to obtain for their estates the services of wood-managers and foresters who have received a more systematic professional training than is attainable at present, they will find the needful means and take the needful steps for the establishment of a forest school. It clearly is their interest to increase the annual yield, and to improve the productive powers, which means the capital value, of their estates. These ends may to some extent be accomplished by a more systematic management of their woodlands, and this again will doubtless be promoted by giving to foresters a more systematic training in their profession than they receive at present. I am, however, fully aware, that there are two circum-

stances which, to some extent, may impede the speedy accomplishment of this idea—the low price of timber, and the very high rent at present obtained by the letting of grouse moors and deer forests. Of these two circumstances, however, the members of this Society are much better able to judge than I am, and I do not therefore attempt to discuss them.

The natural and proper thing in the present case, is for the proprietors to take action on their own account. Should this, however, not be the case, and should the Royal Scottish Arboricultural Society feel themselves strong enough to take the initiative in such an undertaking, this would be an excellent and most important step in the great and good work which your Society has steadily pursued since its formation in 1854. Your aim from the commencement has been, to raise forestry in Scotland to the dignity of a profession. Your "Transactions," the prize essays published by your Society, the excursions to instructive forest districts, the great International Forestry Exhibition at Edinburgh, and the lectures delivered under the auspices of your Society, have all been important steps in the same direction. If the Royal Scottish Arboricultural Society should find itself to be in a position to take the lead in this great movement, the large landed proprietors might perhaps afterwards be disposed to take up the scheme and to work it out on their own account. Something of this kind happened at Weisswasser, which was at first established by the Bohemian Forest Society, and which was thus continued until 1862, when the forest proprietors of the province took over the institution.

In whatever manner the scheme of establishing a forest school for the professional training of wood-managers and foresters may be accomplished, I desire to assure you of my hearty sympathy in the undertaking. In some excellent remarks, headed, "How to make the most of the Excursions arranged by the Society," your honorary member, William M'Corquodale—with whom in 1865 I spent a delightful and most instructive day in the woods of Scone Palace, near Perth—justly drew attention to the advantage of an accurate study of the methods of forestry practised on various estates. Much, very much, of the highest interest to the forester, may be seen and learned in the Scottish woodlands. Different methods of forestry have been practised under widely different circumstances, in some cases with marked success, while in other cases there have been failures. A forest school, if the teaching is of the proper kind, will contribute much to a better understanding of the circumstances which have led to success in the one case and to

failure in the other. The students will be taught to observe accurately, to combine their own observations with the theoretical knowledge they have acquired, and this will eventually enable them to draw correct conclusions from the facts which they have observed. The school, if well directed, ought to become a centre of scientific research, the results of which will contribute much towards a more successful management of the woodlands. The foresters trained at the school will not only be more efficient in their work, but—and this is of very great importance—the better they learn to understand the connection, as worked out by science, between cause and effect in the life of trees and shrubs, the greater will be their enthusiastic attachment to their profession. True, healthy, enthusiastic attachment to one's profession is a blessing in the life of a young man, the value of which it is difficult to overrate. When the time for action comes in the matter of the Scottish Forest School, I shall deem it an honour and a pleasure, if it should be desired, and if circumstances should permit, to help with my advice, and some day, perhaps, to explain to the students some of the conclusions which I have formed as the result of many years' study of trees and shrubs in different countries.

ANNUAL MEETING OF THE AMERICAN FORESTRY CONGRESS.

(*Continued from page* 414).

SECOND DAY'S PROCEEDINGS—(*continued*).

"Forest Cultivation for Profit" was the subject of a well-prepared paper read by Hon. Martin Conrad, of Chicago, which is here given in full :—

I have accepted with much pleasure, the invitation to address you on that department of Forestry which more particularly concerns the present and future supply of timber required for the manufacture of farm machinery and wagons, because I feel that timber culture is not ordinarily a subject of such popular attention as it deserves to be.

My own observations during twenty years of experience in the wagon business have included in their scope the great problem which to-day confronts its chief ally, the lumber interest. I need hardly say that I have noted with much solicitude the wholesale destruction of our forests in all parts of the United States. I use the word "destruction," advisedly, and in its fullest sense; because the removal of timber for actual

use, is but a fraction of the evil causes now at work upon our woodlands—while wantonness and rapacity are doing their worst in this war of extermination. Even the farmer, eager for quick returns, relentlessly uproots the last sapling that the ground may be sown with grain, not thinking of how he is robbing future generations of their just heritage.

In ever-widening circles does this destruction spread over the land. It is but a few years ago that Chicago drew the bulk of its whitewood supply from the State of Michigan—while to-day, that great timber State, in common with ourselves, draws upon Tennessee and other southern districts for this valuable wood. Oak, at that time, was so abundant that it could not be profitably shipped by rail to Chicago from outside a radius of a hundred miles; whereas, to-day, Arkansas and even Mississippi are represented in the oak supply of the Chicago yards. Black-walnut and live-oak are already practically extinct—but long before the culmination of this ominous result, even as far back as 1868—the Hon. T. M. Edmunds in his report to the U. S. Department of Agriculture, foresaw a complete extinction of all timber resources of the United States in about 50 years. This threatened loss alone should demand prompt measures of restraint; but the disasters that we invite, through the climatic changes that must follow our imprudence, are appalling enough to justify the gravest fears.

It is not my purpose to introduce here any lurid pictures of calamities in store for us—as better pens than mine, guided by the hands of science, have already enlightened us as to the probable course of events if the present conditions are allowed to continue. The note of alarm has been sounded long ago, and the stormy floods of the Mississippi and the Ohio have re-echoed it with terrific emphasis.

In proof of the enormous climatic changes that can result from such a cause, I may mention that we have an actual demonstration of the whole process at our very doors. I refer to the northern domain of our sister Republic of Mexico, a section whose former luxuriance of vegetation once proclaimed it a paradise, and whose mineral wealth marked a brilliant page in the chronicles of the sixteenth century. This region is to-day a parched and torrid desert land, treeless and waterless, in whose barren solitudes it would seem that few would have dared to venture.

Yet it is a deeply significant fact that these sunburnt valleys, not only around the city of Chihuahua, but also in many other parts of that section, should be covered with acre after acre of slag from silver ore. It must be borne in mind that in all this strange region there is not a bed of coal, and that, therefore, the extensive smelting operations that are evidenced by the vast fields of slag, must have required an enormous and also convenient, supply of wood for fuel. It follows then that at some distant period of the past dense forests must have covered this land, and furnished the necessary fuel, thereby completely verifying the

statement of Bernal Diaz, the soldier-historian of the Cortez expedition, that they found the region covered with luxuriant woods, verdant valleys and fertile plateaus. It was the treasure hunters then who followed these conquerors that inaugurated the destruction which has extinguished these forests and swept all vegetation from the face of the land.

With nature's sheltering mantle thus removed, the denuded earth, quickly yielded to the influence of an already arid climate, and the desert promptly spread over the area thus prepared for it. The noble forests have vanished at the touch of civilization, and with them also, the life-giving interchange of the clouds and the dew—the balance-wheel of nature's fertility. To-day only a few scattered ruins, here and there, in the midst of lonely wastes of desert, are left, to speak of their former beauty and grandeur. Could the explorer Cortez, and his devout historian, at this moment look upon those beautiful valleys of 350 years ago, viewing again the scenes of their adventure and discoveries, their pious catholocism might be charmed by the sight of the grand cathedral, with its stately towers, costing almost a round million of dollars, as well as the beautiful park at its doors, with its fountains, trees and luxuriance of tropical plants, maintained in this splendour, by the ever watchful, artificial care of man; but, looking beyond this little garden spot they would search in vain for the Eden of primeval beauty that first met their wondering gaze, for their eyes would rest only upon the dreary desolation and ruin which their treasure-seeking followers left behind them.

I do not attempt to trace the exact degree of climatic changes wrought in this particular instance. It is sufficient that the connection from cause to effect is obvious; and to those who have given a thought to the science of forestry, I need not repeat the immeasurable benefits conferred by the presence of forests; how they equalize the humidity, how they furnish shelter, create springs, control the flow of rivers, and protect the proper moisture of the ground. On the other hand, history supplies instances enough of the decay of nations whose decline may be logically traced to the imprudent destruction of their forests, and the consequent disastrous and deteriorating changes in their climate.

Fortunately, we have a prudent example before us, in the countries of Europe, in all of which the forests are under Government guardianship, protecting them against fire as well as spoliation; and however little we may profit by this (for such a system would be a physical impossibility in this country), it may at least serve to remind us that our national legislation tends to the opposite direction, and that at least indirect relief could be afforded by admitting foreign lumber free, and thereby lessening that much of the drain upon our own resources.

Without stopping to discuss this point, it is worth while to see what can be done legitimately in the right direction, and to inquire if there is

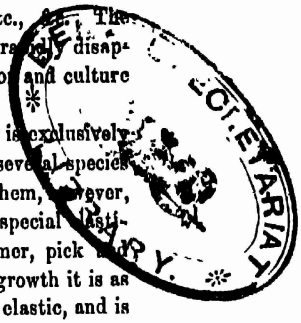
not a chance of redeeming the situation by intelligent and well directed individual action, with a sufficient incentive of personal profit to warrant hopes of success. If I can show that proper efforts in tree culture will prove profitable, and that it is a sure and valuable investment for any farmer and land owner, this may be the means of forestalling evil results and recovering some part of what has been so wantonly destroyed. To investigate this interesting point, I have searched many records and exhausted many tables of statistics, only to be met with a most surprising meagreness of practical information on the general subject. It seems that of late comparatively little personal knowledge of any value has been given to the world, and if there be any reason for this it will lie in the fact that the life of a matured tree far exceeds that of a man, and that consequently no one individual can possibly follow the complete growth from its germination to its natural end. All our knowledge of any given growth is, therefore, a series of tradition, so to say, for each authority can furnish but a small section of personal experience.

In my researches I have consulted a great variety of authors as well as the very latest Government reports bearing on this special subject; but, as already intimated, the practical side of the information they afforded was singularly meagre and unsatisfactory. One author devotes a valuable number of pages to a continuous rhapsody over the "great ash tree" under which he played in the days of his childhood, while a still more pretentious writer in trying to cover his exhaustive subject, "Trees of America," commits the unpardonable blunder of entirely omitting all mention of the oak. That tree, which above all, from a utilitarian standpoint, has earned the right to be called the king of our forests.

It followed, therefore, as a result of my researches, that I was compelled to fall back, in a great measure, upon my early experience with the trees of the forest, together with the practical knowledge of my later years in handling lumber as a manufacturé. Before I present the tabulated results of our calculations, I will give a short description of the five kinds of wood used in the construction of farm wagons, for in these five we have all the varieties that are used in implements and all outdoor machinery. I begin with the oak (*Quercus*). Of the 150 or more varieties of this tree 82 are native to this country. Of these the white oak (*Q. alba*) is the only one in demand by wagon and carriage builders, and as it is at the same time the most serviceable for all mechanical purposes, I will describe only this species.

The white oak is indigenous to the State of Illinois, and is mostly found on yellow loam of moderate fertility, although it also flourishes on our prairie soil. It matures at about an average age of 80 years, after which it gains in size, but with no further improvement in quality, its further growth, being a mere accumulation of adipose, if I may use such

a comparison. When fully developed the white oak is one of the largest and grandest of the entire forest tribe, and it is, of all the deciduous trees, about the most valuable for general purposes. In a wagon it furnishes the hubs, spokes, felloes and all of the running gear except the axles and the tongue, and it takes the lead in all other branches of wood manufactures where special strength, solidity and durability are required, as in ships, car-building, cabinet ware, implements, &c., &c. The natural forests of this supremely useful tree are, however, rapidly disappearing, and, if only on the ground of utility, its preservation and culture should be our very first care.



Next in order comes the hickory (*Carya*). The hickory is exclusively an American tree, of many varieties, one or more of the several species being quite common in every State of the Union. None of them, however, better merits cultivation than the shellbark, for wherever special elasticity is required, as in wagon axles, carriage spokes, hammer, pick and tool handles, &c., it stands without an equal, and in its growth it is as rapid as any of its kind. The timber is heavy, hard and elastic, and is very durable, except when exposed to a foul or moist atmosphere, in which case it decays rapidly. It grows to the height of 60 or 80 feet, with a diameter of 2 feet, and while young is exceedingly graceful and ornamental, so that it might well be cultivated for its beauty alone. For fuel its wood is by far the best in America, and its fruit is the "hickory nut" of commerce.

The "thick shellbark" must not be confused with the species just described. To identify the proper nut for planting I may mention that it is of a globular shape, somewhat flattened, nearly pointless, with a thin, whitish shell, and a large kernel. The nut of the "thick shellbark" is twice as large and has a sharp point at each end, the shell is thick, hard and of a yellowish tinge, while the kernel is very inferior. The leaf of the "shellbark" always consists of five leaflets, while the "thick shellbark" leaf has seven or nine. In this way the difference can be easily distinguished—not only in the seed, but in the young trees as well. Hickory for timber should be grown uninterruptedly from the seed; but it has been asserted that the transplanted tree will bear more and better quality of fruit.

I will now pass on to the well-known ash (*Fraxinus*). To the manufacturer of wagons and agricultural implements this valuable timber is of high importance. It is very durable, and unites lightness, strength and elasticity to such a degree that no other wood could properly replace it for wagon tongues, fork handles and the like.

It exhibits also a highly ornamental finish when used in floors, furniture, wainscoting and interior trimming of dwellings generally Besides all this it is of high rank simply as fuel, and for all these multifarious purposes its consumption has so largely increased, that the better grades

are becoming very scarce and the price has advanced at least 25 per cent. in the last 15 years. I venture to say that unless its cultivation is begun very soon, the present generation will see its last for practical uses in this country.

Indigenous to North America are the white ash, as also the "black," "blue" and "green," but of these the "white ash" is the most valuable. It bears transplanting even when quite well grown, and appears to be quite free from insect foes, so that its cultivation would have at least these important points in its favour.

The next in order is the tulip tree (*Liriodendron tulipifera*), which belongs to the family of the magnolia, and although commonly known under the various names of "white wood," "yellow poplars," "tulip poplar," &c., it does not resemble the true poplar in any respect. There is but one species of this genus, and it is one of the largest and finest trees of the American forests. Hough, in his "Elements of Forestry," speaks of specimens attaining a diameter of 10 feet, and a height of 150 feet. It is found more or less all over the United States, but chiefly in the western forests wherever the climate is not too severe, and where the soil is deep and fertile. Its lumber, known as "white wood," is superior to pine in wagon and carriage building for several reasons. It is stronger, less liable to twist and warp, and has a dense grain, which renders it capable of taking a very high finish without the use of any previous "filler," for which reason also its finish is much more permanent. Its clear qualities also enable its use in wide boards and the largest class of timbers. Its quality of width being a leading attraction, it requires at least 60 years before it attains a marketable size, hence its only value to the producer in the meantime is its ornamental appearance in which it has few equals. Its leaves are large, bright and glossy, its blossoms are of good size, abundant and of an agreeable odour. This tree should be cultivated from the seed and deserves an extensive propagation, for it would be hard indeed to find another kind to fill its place in the wood-working industries, especially wagon making and furniture. Its colour and quality is decidedly affected by the nature of the soil on which it grows, and leads to the various names of "white," "blue" and "yellow" poplar, by which it is erroneously designated. The difference, however, is not externally manifest in the tree. The "yellow" variety is the toughest, hardest and most flexible, which leads to its extensive use in carriage panels, cylinder desks and other work where flexibility and toughness are required.

My list of wagon woods will end with the pine (*Pinus*). This is the only coniferous tree that is of use to the wagon-maker, and it is perhaps fortunate, because none of the conifers are of any value for wagon lumber, until at least 60 years of age, being used exclusively in the form of boards. To make the best lumber, they should be thickly grown when

young, in order to produce a straight tall tree of nearly uniform diameter and free from knots. If grown in isolated situations the tree will expend its vigour in the production of useless side branches, and the trunk will taper very rapidly from the base.

The pine is used for wagon box bottoms, in which the "hard yellow" variety is chiefly employed. Its chief recommendation is its cheapness, since ash is fully its equal in lightness and superior in durability. The fact is, if it were possible to dispense with pine entirely, the wagon would be the gainer—and the list of our wagon woods would be reduced to the four deciduous trees already described.

Here, then, we have five species of forest trees whose extinction alone, or even decline, would be a calamity of measureless extent to our entire nation. But it is a most unfortunate characteristic of our people, that, however imminent the danger, the great mass of them—in fact all but a few specialists—fail to evince the slightest personal interest in the matter. In a spasmodic manner, and to a limited extent, the timber question has received the attention of local, State and national legislation, but to the average farmer, the impending result carries but a very indistinct impression of a vaguely distant future days,—interesting him much the same as the paragraph in his almanac which tells him of the ages that remain before the extinction of the sun. To him it is a matter that concern future generations, but need not worry him; provided he credits the statement at all, which is not always. Moreover, with the great mass of people, the maxim holds good that "what is everybody's business is nobody's business," and however threatening the result,—when it comes to "sowing that others may reap," or making sacrifices from which no return may be hoped for in this life, it is asking a good deal of human nature.

To bring forth adequate results, therefore, will, as I have said, require the powerful stimulus of personal gain whomsoever shall venture his means and his time in this beneficent work. I am aware that it is the unfortunate, though general impression that no profit can possibly accrue to an investment that waits for a forest to grow up from the seed, yet I propose to show that nothing could be further from the reality. I maintain that there is a profit in it, and that a well directed system of cultivation will not only repay the investment richly at an early period, but will be the means of solving the economic problem of our timber supply.

Any line of inquiry looking to the practical solution of this great problem must naturally begin with the number of trees that can be successfully grown on a given space of ground—say an acre—for a unit of calculation; but simple as the question may seem, it is vain to look for it in books. One German authority gives us 300 to 400 trees to an acre, as the results of an 80-year period of cultivation; but unless we are ready to allow a

good deal for the rigorous thoroughness of the forestry systems of the old country, we may be pardoned for doubting these figures. We must reflect that a square rod to each matured tree is a small enough allowance of ground space for a large healthy growth. This gives us 160 trees to an acre, but to be still more conservative, let us knock off 50 more, leaving 110 trees to the acre for the harvest 80 years after planting the seed. This result coincides exactly with the figures given by A. R. Whitney, Esq., the veteran tree grower and proprietor of the well-known Whitney nurseries at Franklin Grove, Ill.

The long practical experience of this gentleman has formulated the following method of cultivation, *viz.* :—

Starting with a planting of 2,720 young trees to the acre, set 4 feet apart, he begins by trimming out after ten years of growth every other north and south row. Five years later every alternate tree in each of the remaining rows is removed, and after another interval of five years more, cull out all imperfect growths, which will leave an average of not less than 110 trees to the acre.

To put this result in marketable form is the next step in our inquiry, that we may determine the money value of our harvest. Our leading hardwood lumbermen count an average of two trees for each 1,000 feet of lumber, and with these factors we may easily compile the following table, showing the value per acre of our 80-year crop of cultivated trees.

Value of acre of timber of 80 *years' growth.*

Number of trees per acre, ...	110
„ „ to cut 1,000 feet, ...	2
„ of feet of lumber per acre, ...	55,000
Price per 1,000 feet, ...	$ 18 00
Value per acre, 80 years' growth, ...	1,100 00
Average value per acre per year, ...	12 37½

Is not this encouraging result worthy of earnest consideration by every farmer and land-owner? A little further reflection will show him that the above result is safely within the reality, as such lumber as we speak of will be worth at least $50 per 1,000 80 years hence, and he may also count upon the yearly trimmings of trees, which increase in value, growing from poles to trees that will make the very best second growth spokes, and carriage stock, as well as all kinds of the most expensive axe, hammer, and pick handles. For these purposes, a tree at 30 to 40 years, is of greater value than when fully matured. Besides this, we will have timber which will be useful for fuel, fencing or charcoal, and will eventually afford a steady revenue far beyond the actual cost of supervision and labour, and in addition to all this, we must bear in mind that the timber left over after the logs are cut, including the tan-

bark, is very nearly as valuable as the logs themselves. But you may say that a period of 80 years—aye, 40 years—is a long time to await the fruits of your labour. True: but cannot its full value be realized just as readily as any of the other permanent improvements on your lands? Your investment in the tree-plantation is not locked up, for should you sell the place at any time, it will certainly take rank with the rest of the improvements as an element of value, and will bring its full price.

No other improvement on your estate can do more than this. The soil itself is certainly not as productive as it was when you first turned the virgin sod, while neither the well-appointed farm-house nor the roomy barn nor any of the other fixtures can ever realize you a cent, except as part and parcel of the whole, and then only when it passes out of your possession by outright sale. It is the sum of all these improvements that enables you to value the property at twenty times its original cost, and not because the land will produce more than it did in the past.

Your investment in the tree plantation must therefore be ranked with the permanent improvements of the place, with the additional certainty that at whatever period of its growth a transfer of ownership may take place it will invariably yield its full value; for while all the rest are undergoing the process of natural decay and require constant labour and expense to keep them in repair, the value of the tree farm until it matures is steadily accumulating with the years, and it must therefore in its intrinsic worth prove the most valuable of all the improvements on your estate.

My subject having been limited to only such woods of natural forest growth as are in present use for the purposes referred to, I must mention that there are numerous varieties maturing at least a decade of years earlier that are possibly better adapted to our prairie soil, which might be substituted in many branches of manufacture without affecting the quality of the article. However, as I have based my estimate of profit upon the oak, which of all species requires the longest time to attain maturity, it follows without argument that with trees of an earlier maturity the average would be proportionally larger.

Having therefore clearly shown that the culture of timber implies nothing in the nature of sacrifice, but on the contrary is a valuable source of revenue, it follows that the great problem can be solved by the incentives which nature herself holds out. She asks nothing without recompense, but offers a far more substantial reward than the mere consciousness of duty performed. Had the proprietors of the Schuttler Wagon Factory planted an oak for each one they cut down for spoke timber since the establishment of their works in 1843, they might to-day make a like amount of second growth spokes from the same ground.

And before going further, let me say that this latter fact has actually

been verified in a most interesting and noteworthy manner. The factory named has just finished a wagon built entirely of cultivated Illinois timber, twenty varieties of which enter into its construction,—none of them over 40 years' growth from the seed. This great variety was sought, only to show what it is possible to produce on our prairie soil, and not for lack of material,—for the entire running-gear could have been made out of one honey locust log in the lot, which measured 18 inches clear in diameter. The entire assortment of woods was furnished by Mr. A. R. Whitney, of Franklin Grove,—of whom mention has already been made —and his testimony on this subject hardly needs stronger proof than this interesting collection of Illinois woods, grown by his own hands. No less praise is due to the far-sighted manufacturers, whose thorough grasp of the question has thus evolved the first wagon of the kind ever seen on the American continent.

To conclude my theme, I would therefore offer the plan of "tree culture for profit," as the only rational means that we have, not merely for recovering what we have lost, but for preventing the evil results which a few more years of our blind folly will surely bring upon us. To this end, I would not only urge upon every farmer to check by all means in his power, the indiscriminate destruction of our trees, but to preserve and foster the young growth as he finds it on his lands,—and above all, to plant at least ten acres on each quarter section of our treeless area, as a systematic step towards correction of the evil.

Having occasionally met with the assertion that the original timber area of our state had not been impaired in the last 40 years, I took pains to investigate this point, and upon consulting the latest reports to the Department of Agriculture at Washington, I find that seven counties show an average increase of 9 per cent., ten claim to have the same area, while a fair computation of the loss in the balance of the counties shows an absolute decrease of the entire area of the State of 52 2-10 per cent., during the stated period of time. The further fact that both quality as well as quantity is rapidly diminishing is shown in the decrease of over 10,000,000 feet of our lumber product in a single year.

As these reports are compiled from the best and most intelligent sources obtainable in each county, the data are as nearly exact as it is possible to obtain such information.

Treating upon this subject in general terms of Southern Illinois, which was formerly covered with timber of valuable varieties, such as oak, walnut, hickory and whitewood, one of these correspondents says: "About one-half of the area has been cleared and put under cultivation. Much of the timber was burned on the ground and all that remains has been culled over and the best taken." Another speaking of Gallatin county, says, in 1857 fully 80 per cent. of this county area was covered with forests. The Wabash and Ohio river bottoms and valleys are covered

with a growth of large, heavy oaks, black walnut, ash and other valuable varieties. All these have long since been utilized for lumber and but little economy displayed in cutting. At present rates of destruction and consumption, in 10 or 12 years no timber worth naming will be found in the county. But over 20 per cent. of the entire area is now in timber of any kind, and the new growth is not of the valuable original varieties.

Increased area is only reported from counties that had very little originally. Lee county is one of this class, and makes the only progressive report of the entire list. The correspondent says:—"When I settled in this county, 49 years ago, about one-twentieth was in good timber. Most of this has been cut off, but very little of the timber land was cleared for farming uses, and as this has produced a new growth, there is now a greater area of natural growth than at the date of first settlements. Where timber has been cut away, the severity of winter and storms at other seasons of the year has been intensified.

"Much tree planting has been accomplished, and when this has been done on the prairies, and where the natural re-invested forests have again attained size, there has been a perceptible modification of climatic conditions."

This is a very interesting report, but I am hardly prepared to admit the possibility of producing climatic changes within such narrow limits. To create any effect it requires a larger area than that of a single county in which the timbered portion is but a small fraction of the whole, but, nevertheless, we must say that Lee county is moving in the right direction. Were all to do likewise this inevitable consumption of our forests might be arrested instead of being encouraged by such statements as the one which I am herein forced to controvert, for it lulls to a dangerous indifference at a time when our vigilance should be aroused.

Let us not then, ostrich-like, bury our sight to avoid the apparition of danger nor yet believe it far away, for another generation may find itself battling with the consequences. For so surely as the forests are swept away so surely will our mighty assistants, the clouds and the sunshine, the winds and the rain, refuse their further services in calling forth and nurturing our growing crops. But released from all control they will descend upon our fields only to blight and destroy. Instead of the zephyrs of spring we have called forth the black demon of the cyclone, and for the gentle and life-giving rain we have exchanged the terror of the mighty flood alternated with the hot breath of the drought. This is what we shall have to reap for so wantonly wasting that which we should have used with prudence, and upon which future generations have a claim as well as ourselves, for it certainly was never intended that we should destroy any of the elements upon which depend the welfare of posterity.

Baron Ferdinand von Mueller, beautifully expresses the situation when he says:—

"I regard the forest as an heritage, given to us by nature, not for spoil or to devastate, but to be wisely used, reverently honoured and carefully maintained. I regard the forest as a gift entrusted to us only for transient care during a short space of time, to be surrendered to posterity again as an unimpaired property with increased riches and augmented blessings, to pass as a sacred patrimony, from generation to generation."

(To be continued).

THE SCARCITY OF FUEL AT DARJEELING.

We publish the following letter from Mr. Prestage, dated 20th June, to the Chairman of the Darjeeling Municipality, with some comments :—

1. In continuation of my previous communications, more particularly the Darjeeling-Himalayan Railway Company's letter No. 2221 of the 27th May, 1886, to you as Chairman of the Road Cess Committee, I now have the honor to address through you the Commissioners, soliciting that urgent attention may be given to the increased and growing cost of living in this sanitarium, and that an effort may be made to cheapen the chief supplies which are necessaries to the most needy.

2. I am glad to report that arrangements have been made by which some of the largest consuming establishments will draw their chief bazaar supplies from distant, new and cheaper areas, and which will, it is thought, cause less demand on the local markets, and a consequent reduction in the cost of fowls, eggs and such produce; but I would earnestly solicit that a strong Sub-Committee of the Commissioners be appointed to consider the following, or any more workable proposals they may bring forth.

3. I have been informed by one of our late Chairmen, that since 1874 the price of firewood has increased from Rs. 15 to its present cost of Rs. 32 per 100 maunds, so that one of our main necessaries has in a few years more than doubled in cost, but what is still more serious is, that from the present control and working of our sources of supply, and the neglect to produce and reproduce, there is reason to fear that another 14 years may show a further increase of cost of more than 100 per cent.

4. Interested as I am with my friends very largely in the prosperity of the district and the station, I have given special attention to the causes of the unfortunate increases in the cost of timber and firewood, and which are as under.

5. Instead of the supply of timber, as in most wood-burning countries in Europe, being under the control of the Municipality, or a body

interested in giving abundant and cheap supplies, or the forests and waste areas nearest the stations being rendered productive or reproductive, the whole production, or rather the exhaustion of the forests, is under the control of a foreign feeble intermediate department, which fails to reproduce, and is indifferent to the increased cost of fuel and timber to the consumers.

The Remedies are—1*st.* I beg to urge that the supply should be as in Europe under the control of the Municipality.

2*nd.* The Forest Department should be deprived of all trading powers and desires, that it should only be required to produce technical advisers to Government, with instructions mainly to produce and reproduce, and not exhaust particularly near the large consuming areas.

The mode of proceeding advised is—

(*a*). For the Municipality (through a contractor who will be forthcoming) to re-purchase from Government the 700 acres of forest land on blocks Nos. 44 and 45 on the north of Ghoom ridge for the original purchase money Rs. 14,000, less say half the revenue the Forest Department has already netted from the blocks; it is estimated that these blocks would give a full supply to the station for the next six years.

(*b*). The Government to undertake to transfer to the Municipality additional areas required abutting to give a further supply for a total of 20 years, at the rate paid per acre by Government for blocks Nos. 44 and 45, *viz.*, Rs. 20 per acre.

(*c*). The Government to place at the disposal of the Municipality any selected officers and employés of the Forest Department capable of reproducing and advising in forest operations to the greatest advantage.

(*d*). The Government to supply at actual cost seedlings and any Forest Department produce and materials required.

(*e*). The Municipality (through the proposed contractor) to construct or arrange to construct a good cart road or railway on the level from the 48¼ mile on the Darjeeling-Himalayan Railway to the Ghoom ridge through the new unproductive lands (late Municipal blocks Nos. 44 and 45) and the Soom Tea Estate lands to the neck on the Ghoom ridge, by which a level or descending gradient would be got from the neck into Darjeeling, and the cost of hauling into the station would be much reduced.

(*f*). The Municipality to plant the 400 acres, now unproductive land, north of Ghoom almost abutting Darjeeling, with quick growing trees that will yield good firewood in 20 years, and replant

the areas in blocks Nos. 44 and 45 as they are exhausted, due regard to be had for preserving grazing ground for sheep and the rearing of shrubs most sustaining to cattle.

(*g*). The Municipality by water-power or otherwise to lift up the timber to the rails from the lower levels of the blocks.

(*h*). The Municipality to erect such machinery as is used in Europe for the purpose of sawing up and splitting the firewood, and prevent the heavy waste of timber and labour by the present hand process.

(*i*). The Municipality to establish good well-covered fuel depôts abutting the railway at the junction with the Ghoom ridge new road or railway, with the Darjeeling-Himalayan main line (48¼ miles), also at the foot of the Kog Jhora road and in the bazaar (Bird's godown is proposed).

6. The price to be charged by the proposed contractor for dry split firewood at the depôts is not to exceed Rs. 30 per 100 maunds.

7. I am prepared to carry through the above proposals, and will find a substantial and reliable contractor to do so if the Municipality can and will influence the Government to the extent proposed.

8. In judging of this matter, it should be kept before us that the exceptionally low and unremunerative rates at which Assam coal has been delivered in the district for the last two years failed to cause an increase in the consumption of that fuel, and I am of opinion that until a through connected line is constructed between the Northern Bengal State Railway and the Brahmaputra, that we cannot hope for a permanent supply of such fuel at sufficiently low rates to bring about increased consumption and less demand for wood fuel.

9. I have not alluded to the advantage to the station of the now large barren areas north of Ghoom ridge again being converted into forests, and of the new road or railway extension giving easy access to the virgin forests nearest to the station.

Our remarks on the above are as follows :—

Para. 2.—The arrangements referred to have made no appreciable difference so far in the cost of fowls, &c., in the local market to the general consumer. The cost rises year by year, and is likely to continue to do so as the number of Europeans in the station and at Jalapahar increases, notwithstanding the alleged improved import arrangements.

Para. 3.—The inspection of the recorded *retail* prices current compiled weekly in the Deputy Commissioner's office, will show that the price of firewood in the station of Darjeeling has only varied as follows in the last 14 years :—

			Seer per Rupee.		Per 100 Maunds.
June	1874,	... ...	200	=	Rs. 20
December	1875,	... ...	160	=	„ 25
June	1876,	... ...	200	=	„ 20
June	1877,	... ...	160	=	„ 25
June	1885, } June 1888, }	... ...	120	=	„ 33·3

Not exactly "more than double," as stated in the letter. This "*retail*" rate is, however, for small purchasers of a maund or less from retail merchants in the bazaar; the Forest Department depôt rates have been as follows for lots down to 12½ maunds since 1887, which was the first year in which the Department brought firewood into Darjeeling bazaar for sale :—

1877, ... Rs. 25 per 100 maunds.
1885, ... „ 30 „ „
1887, ... „ 15 „ cord.

The cord (sale by measurement of firewood stacked) was adopted in the interests of purchasers, so that the subordinates of the Department should gain no advantage as to stock in hand by wetting the wood previous to sale to make it weigh more. The cord of fresh cut wood was found to weigh about 60 maunds on the average. The rate per 100 maunds was raised to Rs. 30 in 1885 by order of Government, to allow private dealers a chance, as they complained that they could not compete with the Departmental sales at Rs. 25 ; since then the Department keeps a reserve stock on hand, from which it is optional for purchasers to buy, or they can go to the general dealers : the result so far is that departmental sales have not fallen off. Private dealers now deliver on road, most convenient to purchasers' houses in carts at Rs. 30 per 100 maunds.

"Production and reproduction" in the Darjeeling forests has cost the Department as follows, as I gather from the printed reports :—

	Artificial reproduction. Rs.		Artificial reproduction. Rs.
		Brought forward,	28,594
1874-75, ...	5,230	1881-82, ...	4,145
1875-76, ...	4,976	1882-83, ...	3,608
1876-77, ...	8,577	1883-84, ...	2,856
1877-78, ...	1,102	1884-85, ...	3,446
1878-79, ...	4,096	1885-86, ...	2,064
1879-80, ...	2,789	1886-87, ...	1,950
1880-81, ...	1,824	1887-88, ...	2,425
Carried forward,	28,594	Total, ...	49,148

Or an average of Rs. 3,511 per annum, the average surplus of working these forests having been Rs. 5,382 for the same period, without allowing for share of general direction charges. The Department can hardly, under the circumstances, be fairly charged with "neglect" in this matter.

Para. 4.—The "unfortunate increases in the cost" are due primarily to the further distance fuel and timber has now to be carried, and to the increased cost of labour since the introduction of the Local Labour Act.

Para. 5.—The charges hitherto brought against the Department by the writer of the letter have been that it declines to allow the Darjeeling-Himalayan Railway to cut what trees it requires where it likes. He now accuses the Department of exhausting the forests. Had the writer of the letter had his own way, there would not be a tree fit to produce timber in the forests by this time within about 15 miles of the line of railway; he has, however, lost every case he has sent up to Government (and they are many) containing charges of obstruction and what not against the Department, notwithstanding that he dubs it (in Railway parlance?) a "foreign feeble intermediate" one.

The Remedies.—*2nd.* I should think the writer would hardly wish Government to trust to the advice of the Department after the opinion he has given of its works above, which he here again accuses of having "exhausted" its forests.

The mode of proceeding.—(*a*). It would hardly need much sagacity to guess who the "contractor forthcoming" would be. These blocks 44 and 45 having been worked out by the Department as far as its "feeble" technical knowledge and management considers safe, the "contractor forthcoming" (who has presumably been interviewed by the writer of the letter) evidently makes a very sanguine estimate in expecting to get a "full supply" to the station for the next six years out of the area.

(*b*). There is something delightfully "childlike and bland" in this proposal. The Municipality sold Government land almost cleared of timber, and the writer of the letter wishes forest carefully conserved and almost fully stocked at the same rate from Government.

(*c*). Any one would think after the remarks preceding, that the "contractor" (with the help of course of the writer's experience) would be above taking advice from members of the "foreign feeble intermediate" Department.

(*d*). This has a decided touch of the "childlike, &c.," as at (*b*).

(*e*). The "proposed contractor" would probably profit by this very considerably. It is doubtful if any one else would benefit.

(*f*). The mixture of a plantation of quick growing trees "to yield good firewood in 20 years," and the use of the area at the same time for sheep grazing is quite "too too." A sight of the bare hills on which the grazing is now allowed, about three-fourths without a shrub, and about one-fourth bare rock or slips, ought surely to convince any one (the feeble intermediate Department included), that it is absurd to object to grazing anywhere, especially of course in artificially planted areas.

(*g*, *h* and *i*). Presumably through the "proposed contractor"?

6. The Municipality having paid the "proposed contractor" (say) from two to three lakhs for the preliminary works proposed by the writer of the letter, will of course make a handsome profit by selling at Rs. 30 per 100 maunds.

7. The "contractor" again!

8. The well-known boast of the writer of the letter about twelve months ago was that the Forest Department might shut up its depôts, as before the stock of fuel then in hand was worked out nothing but coal would be used in Darjeeling and the Tea gardens along the line of railway.

9. The Municipality asked the "foreign feeble intermediate Department" to undertake the re-stocking of this area about 18 months ago, but on being informed that it must forego its grazing revenue for some years, took no further action in the matter.

A NOTE ON THE APPARATUS REQUIRED FOR COLLECTING INSECTS IN INDIA.

Killing bottle.—A simple and effective killing bottle is made as follows:—

Two or three lumps of cyanide of potassium, each as big as an acorn, are dropped into an empty quinine or other wide-mouthed glass bottle: enough plaster of Paris, made by mixing the dry powder with water to the consistence of cream, is poured in to cover up the lumps of cyanide. The bottle is left open for a few hours, until the plaster has set hard, when it is tightly corked up, and after remaining closed for a day or two, is ready for use.

The plaster and cyanide set into a solid mass, which sticks fast at the bottom of the bottle, the object of the plaster being to hold the cyanide in place, and the whole mass has a smooth, even surface, from which insects can be easily picked up, the glass sides of the bottle enabling the insect to be easily seen.

A few minutes in a good killing bottle, thus made, is sufficient to kill most small insects, but some of the larger species of insects require to be kept in it for several hours to insure their not reviving.

A killing bottle, when carefully used, should last for a good many months, the great thing being to keep it tightly corked up and always to close it quickly, after taking out or putting in an insect, thus allowing as little as possible of the cyanide vapour to escape.

Old quinine bottles do very well for all ordinary purposes, as killing bottles, they are cheap and of a convenient size, but are not big enough to take the largest moths and beetles, so for these a larger size of bottle should be obtained.

Killing butterflies.—All insects can be killed in a killing bottle, but for butterflies it is quite sufficient to fold the wings together over the back, and then to pinch the thorax between the finger and thumb; this kills the insect without injuring its wings.

Preserving insects in alcohol.—Eggs, pupæ and soft-bodied insects, (such as caterpillars and grubs,) can be at once killed and preserved by dropping them alive into strong alcohol, where they do not putrefy or shrivel up, as they would be liable to do if it were attempted to dry them.

Small insects.—All small insects, when taken out of the killing bottle, should be at once pinned, or else gummed on to little pieces of cardboard or mica, great care being taken in gumming them not to smear the gum over their bodies; the little bits of card or mica can be pinned down into cardboard boxes, and thus closely packed to travel.

Medium sized insects.—Medium sized insects (including all butterflies and most moths) can be wrapped in soft paper, when they come out of the killing bottle, and as soon as they are dry, can be packed lightly but closely together into tight-fitting tin boxes, with a few lumps of camphor or naphthaline; in this way they can be sent long distances by post without fear of injury. Simply drying the packets, which contain the insects, separately in the sun and air for two or three days being quite sufficient to preserve their contents.

Large insects.—Large insects, especially those with stout abdomens, require to have the contents of the abdomen removed, and the shell stuffed with cotton wool, after which they can be dried and packed like the medium sized insects above.

Keeping dried insects.—All insects, when thoroughly dried, can be kept in any close-fitting box or case which contains a little camphor or naphthaline. It is essential, however, for the case to be itself perfectly dry and practically air-tight.

Insect net.—A simple and serviceable net for catching insects can be made out of mosquito curtain stretched on a cane hoop with a bamboo handle attached.

Forceps.—A pair of forceps, which can generally be made locally, will always be useful for picking up small insects.

On sending insects for determination.—In sending specimens of insect pests to entomologists for determination: each pest should be kept carefully by itself, and when possible specimens should be sent, in all stages of development and in considerable numbers, accompanied by any notes on the habits of the insect and a full account of the nature and extent of the damage, also any specimens (such as half eaten leaves, bored wood, damaged grain, &c.,) which throw light on the nature of the attack.

Live specimens are always easier to make out than dead ones, so they should always be sent when there is a reasonable probability of their surviving the journey; chrysalides and cocoons, especially, should be sent alive, packed in a perforated box with leaves or grass.

So little is at present known of Indian entomology, that the exact determination of species is often a matter of very great difficulty. Hence the necessity of furnishing full particulars and also of collecting a considerable number of specimens in each case, as these are often of great assistance in making out the affinities of an insect, and in any case form a most valuable record for comparison.

Materials.—The following materials are sufficient for collecting a vast number of insects, and would probably last one collector for at least a year.

In the absence of price lists, it is impossible to say what the exact cost would be, but from Rs. 5 to 20 would probably buy all that could possibly be wanted by one collector.

For collecting ordinary dried insects the following will be sufficient:—

Four ounces of cyanide of potassium.
A pint bottle full of dry plaster of Paris.
One pound of camphor (or better naphthaline).
A couple of wide-mouthed bottles with corks.
Three yards of mosquito net.
A few pieces of cane and bamboo.
Some small tin boxes.
A packet of thin white brown paper.
A pair of forceps.
A needle and thread.

A ball of string.
A yard or two of mulmul.
A pocket knife.

If larvæ and other soft-bodied insects are to be collected, the following should be added :—

One quart of strong spirit (or better pure alcohol).
Same empty bottles with corks.
A little wax for closing bottles.

If very small insects are to be collected, the following should also be provided :—

Two or three sheets of fine cardboard.
Two or three packets of small pins.
An ounce of gum arabic.
Small cardboard boxes of various sizes.

Rough collecting.—The above list contains all that is likely to be wanted by a collector ; but a great deal can be done with very much simpler materials ; for instance, when other apparatus is not at hand, any insect can be killed and preserved by dropping it alive into a bottle of alcohol (or even whisky), though its colours will always be more or less damaged in the process, and it will consequently not make a good cabinet specimen afterwards.

14th September, 1888. E. C. COTES.

COMPENSATION UNDER FOREST ACT FOR ILLICIT FISHING.

I UNDERSTAND that the draft of a new Forest Act is being considered at Simla, and as not even the wisest amongst us can grasp all the points in which the present Act requires amendment, will you permit me to add my little quota ? In 1881, fishing with nets was prohibited within the reserved forests of the School Circle, North-Western Provinces, and the punishment for contravention of this rule fell under Section 25 (*i*). It was not always advisable to send such cases to a Magistrate, and in consequence Section 67 was resorted to in dealing with them.

Some years afterwards the Local Government passed certain orders regarding the amount of compensation leviable, and the maximum was fixed at ten times the value of the produce in all cases dealt with under Section 67. Time went on and it was discovered that to take even the maximum compensation in fishing cases did not act as a deterrent, because the value of the fish

caught, was in most cases so small. Application was then made for Forest officers to have the power to confiscate the net, obviously the best punishment in addition to a small fine. On this application the Local Government has just passed orders—(1), that it is not advisable that any exceptions should be made to the law (regarding confiscation) as at present constituted; (2), that fish do not come within the definition of forest produce, and that (3), subject to a maximum of Rs. 10, the Forest officers will assess the value of the nets or tools which would be liable to confiscation had the case gone before a Magistrate, and to this they may add a further sum on account of damage (if any) proved to have been committed.

Now when a man fishes illegally in the streams of the Dehra Dún Division, he commits no assessable damage whatever; the value of the small meshed circular cast net he uses is about Rs. 3; he may catch Rs. 3 to Rs. 4 worth of fish, which he sells, hence according to the latest orders of the Local Government, the man practically gets off scot free. When fish was considered forest produce (as it most certainly is, just as much as shells, bones and horns), and we were empowered to take up to ten times the value of the produce, the punishment was in some cases sufficient; but now it is in all cases insufficient.

What is required here is power to confiscate the net. It will at least take the offender some time to make a new net, and meanwhile the fish will have rest; but as matters stand at present under the latest orders, it will be worth while for a man to net regularly; for once he is caught, he will escape detection ten times, and make a good living out of it. The only remedy is to send all such cases to a Magistrate, simply in order that the net may be confiscated; and this I shall take care to do in future.

Let us hope that in the amended Forest Act, if there is to be one, fish may be classified as forest produce, and that Forest officers may have power to confiscate the nets.

A. SMYTHIES.

JJ. Reviews.

FORESTRY IN BOMBAY.*

The areas in square miles of reserved and protected forests in the three Circles of the Bombay Presidency are as follows :—

	Northern Circle.	Southern Circle.	Sind.	Total.
Reserved forest, ...	7,231	1,822	700	9,753
Protected forest, ...	1,080	3,412	*Nil.*	4,492
Total, ...	8,311	5,234	700	14,245

During the year, 292 square miles were added to the area of the reserved forests, whilst that of the protected forest was increased by 124 square miles.

Considerable progress has been made in the settlement of forest rights, but exclusive of demarcation and compensation, the cost of this settlement during the year was Rs. 1,68,429, or about Rs. 292 per square mile of forests settled, and as this is higher than in any other province in India, and the estimated total expenditure for the settlement of all the reserves at this rate would be Rs. 17,00,000, the Government of India is naturally anxious that some steps should be taken to reduce it.

We read that no rights, except of way and water access, have been found to attach the forests of the Northern Circle, and there is not a word about any rights in Mr. MacGregor's report of the Southern Circle, nor in Colonel MacRae's report on Sind, where the forest settlement has now been completed.

* Progress of Forest Administration in the Bombay Presidency, including Sind, for 1886-87, with the usual Government orders.

Although there are no rights, there are very extensive privileges conceded in the forests of the Northern Circle, the value of which is estimated as considerably above the whole revenue collections, being worth Rs. 2,55,000 in the South Thána Division, and for grazing alone Rs. 55,000 in Poona, but we are glad to read that these privileges, chiefly of free grazing, free cutting and removal of grass, minor produce, thorns for fences, dead leaves and dead wood, can only be exercised in unclosed areas which are defined by the Revenue officers after consulting Forest officers.

The privilege of taking free timber for agricultural and household purposes of all but 17 kinds of reserved trees must, as Mr. Shuttleworth remarks, lead to the creation of extensive blanks in such portions of forests, where none, or very few, of the reserved kinds may be represented.

The following remarks by Mr. Shuttleworth regarding the wholesale removal of thorns deserve the close attention of Government :—

"There is no longer room for doubt that the Forest Department can by simple and inexpensive measures restore timber to all the bare hills of the Deccan and convert them into reservoirs for impounding the rain that falls upon the hills. That these hills will grow timber of large size, is evidenced by the presence of sacred groves which have remained here and there, superstition having guarded them against the desolating axe. But there is a new difficulty appearing in the path of reboisement, *viz.*, a demand for thorns for fencing purposes, and claims made by some Revenue officers to have the power of granting thorns to applicants from the hill-sides. To fence in an acre field with thorns necessitates the stripping of several acres of semi-denuded hills undergoing reboisement, while the thorns dry up and rot away soon after they are put down, high winds sweeping over the Deccan plains blow them away, they are appropriated for firewood, and the dry thorn fencing of a field has to be replenished before the crop it was intended to protect has been harvested. The thorns in reservations under treatment for reboisement create soil, they impound the rainfall, they nurse seedlings to produce timber and firewood, and they have a climatic value upon the hill-sides."

As regards survey, we read that the Government of India is not convinced that the scale of 8 inches to the mile as proposed for the Bombay forests is essential, whilst the cost of the survey of the Thána forests by Colonel Pullen, Deputy Superintendent, Survey of India, *viz.*, Rs. 257 per square mile, is very high, and the progress made slow.

The Government of India has, however, decided against the work being entrusted to a special Forest Survey Branch.

The Working Plans Branches in the different Circles are commencing operations, and we are promised some simple working plans based on area, and the sylvicultural requirements of the forests, whilst the conditions for working plans in the Thána forests are graphically described below by Mr. Shuttleworth—

"The condition of the Thána forests does not favour schemes of very scientific elaboration, and the surrounding circumstances point to certain factors which must regulate to a great degree the internal economy of working schemes for the Thána forests. The existence of a large local population depending for subsistence in a great measure upon the labour to be provided by felling, collecting, stacking, exploiting timber and other forest produce, and also making a constant demand upon the produce of the forest for agricultural and domestic requirements; the country being a succession of lofty hills and narrow valleys, with the forest estates spreading over the hills, and the villages in the valleys intermingling with the forest areas; the teak being the predominating tree in the forest and possessing vigorous powers of reproduction by coppice shoots, the ill-treatment the teak and its associates in the Thána forests have received from man for years past, and consequently the impaired condition of the forests; the great value of all forest produce owing to the demands of a very large local population combined with the demands of the city of Bombay at the door of the forests with a population of 800,000, and the city of Poona connected with the forests by railway communication 50 miles distant from the nearest point; the absence of timber of large scantling, and the ready market for small timber, which better serves the necessities of the peasantry, and for every stick of firewood; the facilities afforded by three lines of railway, tidal creeks, and other channels of inland navigation, cart-roads and tracks penetrating up to the head of every valley, and up the sides and summits of many hill ranges, for smuggling timber and robbing the forests; and the very large section of the population who are in league with timber-dealers and ever on the look out to make raids upon the Government forests and run timber into Bombay;—all these considerations point to the location of 'coupes' of comparatively small size each at almost regularly recurring distances all over the forest area, the size of a coupe varying according to situation from 30 to 70 acres, so that proper supervision may be exercised over the 'exploitation' of their material, under which term besides actual fellings may be included every operation to be performed in the coupe, such as valuation of the crop, marking and registering the reserves, testing the registers after the felling is completed, counting and classification of material extracted, and other minor works; and so that forest villagers and the peasantry

generally may not have to go inconvenient distances from their houses for labour, and prohibitive distance in the light of the cost of carriage for their supplies of timber and other forest produce to be obtained free or on payment, and for the enjoyment of pasturage in forests by their cattle; and that a wood-cutting race may find a congenial honest occupation in every direction close at hand, and thus be diverted from plundering the forests which are so exposed on all sides.

"It was decided, after careful investigation into the rate of growth of timbers, and study of the biology of the teak tree in the Thána forests, that a rotation of 40 years might safely govern the differentiation of the forest blocks. The length of rotation having thus been fixed, and the approximate size of coupes having been determined, the arrangement and distribution of forest working blocks followed in natural sequence, their extent and position being controlled also to a great extent also by the necessity of obtaining suitable physical boundaries."

We read that a large number of the forest subordinates in the Northern Circle have been dismissed during the year for dishonesty, this includes several range officers, and points to the necessity for raising the status of such officers and their *esprit de corps* by careful selection followed by a good technical education.

We read that the forest classes at the Poona College of Science contained two scholars in the senior and two in the junior class, and that two men passed the final examination, both of whom found employment in Native States. This does not look as if the Bombay Government was at all in earnest in the necessity for educating its Executive Staff, and shows a marked contrast with the Madras Presidency, which had 19 of its Staff attending the lectures at the Dehra Dún Forest School in the past year.

The following remarks are made by the Government of India on the general protection afforded to the forests of the Bombay Presidency:—

"The general protection of forest estates seems to have been satisfactory. Including all cases compounded, the breaches of forest rules discovered amounted to less than one case for every two square miles. The protective Staff is more numerous in Bombay than in any other Province in India, and the area of each beat does not average more than in European countries; but in some districts the Government forests are so intersected by private property, and the boundaries are so irregular, that the Government of Bombay considers it necessary that Section 41 of the Forest Act should be amended, so as to give power to exercise control over all forest produce in transit, whether derived from Government lands or private property, in order to protect the Government forests more effectively from being robbed."

The following statement shows the results of fire protection during the year:—

Circle.	*Area in square miles.*			Proportion of failures to area attempted.	Cost per square mile protected	Proportion of area under fire protection to total area of forests.
	Attempted.	Failures.	Protected.			
				Per cent.	Annas.	Per cent.
Northern, ...	8,038	275	7,763	3	1	97
Southern, ...	2,341	493	1,848	21	5	45
Sind, ...	699	19	680	3	..	100
Total { 1886-87, ..	11,078	787	10,291	7	2	78
Total { 1885-86, ..	11,429	663	10,766	6	2	88
Increase or decrease in 1886-87, ...	− 351	+ 124	− 475	+ 1	..	− 10

"A comparison with that of the previous year shows that the area protected in the Northern Circle increased by 1,424 square miles, whereas in the Southern Circle a decrease of 1,912 square miles took place."

Fire conservancy arrangements require revision in the Southern Circle, where Mr. MacGregor appears to disbelieve the figures of the Divisional reports, and where he states that the fires do incalculable mischief, no seedlings, but only coppice shoots being able to survive the fires.

Mr. Shuttleworth evidently does not exactly agree with Professor Wallace's dictum that forest fires are of great benefit to villagers, in the following sentence:—

"A sustained improvement in all branches of forest conservancy and works ought to be the aim of the Forest Department in India; and this can, as far as the forests of the Northern Circle are concerned, be best secured, both as regards economy and results beneficial to forests, by permanent establishments being taught how to perform the different duties of protection, &c., and by inducing villagers to co-operate with forest subordinates in preserving forests against visitations by fire and in extinguishing fires when they do occur: in this view, rewards are given to villagers for the labour provided and the ready assistance tendered by them in burning fire traces and in fighting against and putting out fires.

The expenditure in the year on these accounts has amounted to Rs. 470-7-9."

The Conservator of Forests in Sind, makes the following interesting remarks about forest fires :—

"In Upper Sind the forest fires were very extensive and destructive. It was feared that this *would* be the case. There was much cattle-disease in the district, and the cattle-breeders believed that it would not cease till the old reeds and grass had been burnt. There was much truth in this, as the dead cattle were lying rotting in the high reeds and grass and infecting the sound cattle grazing in them. The people to save their cattle set fire to the grass wherever they could do so without fear of detection, and an area of nearly 11,000 acres was burnt. About half was chiefly reeds and grass of not much account, but the rest was good jungle, including a great number of compartments under reproduction that were nearly ready to work again. These compartments have been worked once already, and their destruction causes a loss of many years' protection. Only one case is reported of a man being caught setting fire to a forest and being convicted of the offence.

"In Central and Lower Sind the forest fires were unimportant and very little damage was done by them.

"The protection of the Upper Sind forest from fire, especially in a season like the one under report, is simply hopeless. The only practical plan of saving good jungle from fire in this district is what I have before advocated, but which I regret does not commend itself to the Government of India, and this is to divide the forests into grazing and timber blocks. The former to consist of the tracts of reed and coarse grass with a few scattered bushes struggling for existence against the recurring fires. The area set apart for grazing should be freely burnt so as to provide fresh young grass. This would increase the revenue from grazing fees, benefit the people and tend to save the better part of the forests from fire.

"As I have said before, fires in such jungles are likely to do more good than harm.

"If the reeds are protected they are sure to destroy when they do catch fire any tree growth that may come up with them, and their being burnt is merely a question of time.

"But if the reeds are burnt and the fresh shoots kept down by cattle, the next inundation may drown the reed roots and give the tamarisk and kandi a chance of over-topping the next crop of reeds and grass that may come up.

"The Shahpur forest is a case in point. All the lower part of this forest I can remember as a sea of reeds and grass the scene of extensive fires. Some years ago the entire area of low-lying land was burnt very

late in the season. The next inundation submerged the roots of the reeds before they had time to shoot again and killed them, the next year the tamarisk coppice that had been kept down by the fires came up with such strength that it over-topped the grass, and now that part of the forest is a dense tamarisk jungle safe from fire, and will, in a year or two, yield immense quantities of locomotive fuel. It was worked a little for thin wood last year.

"By widening the compartment lines of the squares to be burnt, and choosing a still day for firing the reeds, the risk of the fire extending beyond the limits it was intended to reach would be very slight."

There appears to be trouble about collecting grazing dues in the Northern Circle, as the Forest guards are not allowed to interfere with the herdsmen except in closed areas, and thus many cattle graze illicitly.

We fail to see in the following remarks of Mr. Shuttleworth any traces of the hostility to agriculture which Professor Wallace imputed to Forest officers :—

"It is certainly the duty of the Forest Department, seeing what are the circumstances surrounding our forest reservations, to provide the largest extent of pasturage that can with proper regard to the interests of forestry be provided, and an enormous area can with comparative safety be opened to grazing in all the divisions so long as a limitation of the number of cattle to be entered upon particular areas is enforced, and a grazing season is observed. It has been proved conclusively that the improvement of the grass crop upon the hills of the Deccan, in quality as well as yield, is the natural consequence of the reboisement of the hills, and that a good and abundant growth of grass can in no other way be secured than by bringing in the first place soil and moisture upon the slopes."

Regarding natural reproduction and the effects of protection, we read that in the Konkan the spontaneous growth of vegetation is very vigorous, in certain parts of North Thána, khair seedlings and teak saplings are very noticeable. In East Khandesh, although nearly all seedlings which naturally appear during the rains apparently wither and die, when three or four months old, so that very few are to be seen in the hot weather, yet their roots survive and sent up collum shoots in the next rains, so that after a few years the plants get established.

The Divisional officer of Nasik reports :—

"The general improvement in the state of the hills and lands in our charge has been commented upon very frequently by many people whom I have come across in my travels during the past season. This is very

noticeable in the forests of the Yeola, Nándgaon, and Málegaon ranges; again in the Ghát forests and in those below the Ghâts the forests are carpeted with a strong growth of seedlings, the seeds of which Nature has herself sown. In the Peint Range the difference between the growth of recent and of former years is most marked. The latter consists of trees hollow, and crooked; and the former of beautiful well-grown poles."

Mr. Wroughton, the Divisional officer of Poona, states that with the Deccan system of broad-cast plantation by Forest guards, it is difficult to distinguish between natural and artificial reproduction. As we have already mentioned, the uncertain protection from fire in the Southern Circle, prevents natural reproduction by seed, and only allows coppice shoots to survive.

The following remarks of Colonel MacRae's will explain the system of reproduction in Sind, which appear to be all that is required :—

"In Upper Sind 48 compartments, including a good many that had been burnt, with an area of 6,840 acres, after being cleared of all available material for locomotive fuel were closed for natural reproduction during this year. But camels and goats only are excluded. Horned cattle do not eat tamarisk, and kandi coppice is so well protected by its own thorns that it is safe from them; any damage they may do is more than compensated for by their keeping down the grass which is such a source of danger in young forest. In Central and Lower Sind an area of 4,966 acres was closed for reproduction. In these parts of the Province where much babul grows, the compartments under reproduction are closed to horned cattle as well as all other kinds of beasts.

"The results of closing for reproduction are very satisfactory where the young growth has not been burnt or killed by frost. The damage by fire is confined to Upper Sind and has been very great. The damage done by frost is comparatively trifling, the roots of the majority of the babul seedlings being still alive though the tops had been killed. Frost seldom destroys the whole crop of seedlings, the greater part of them come up again, and after that as a rule they are safe except from very severe frost."

As regards artificial reproduction, a good deal of broad-cast sowing with variable results appears to be done in both Circles of Bombay, whilst in Sind natural means are almost entirely trusted to.

Very little expenditure was incurred on roads, *viz.*, Rs. 600 in the Northern Circle, Rs. 1,394 in the Southern Circle and nothing in Sind. We read that the Presidency has been already

opened out by roads in all directions, and that cart tracks render the remotest spots of the forests accessible. The Local Government has, however, informed the Commissioners that should any road construction be contemplated by Local Boards likely to be of service to the Government forests, that some assistance from Government may be looked for.

A certain amount of building work has been done, Rs. 11,207 having been spent on buildings and other works in the three Circles during the year.

There is little to say about works of improvement, climber cutting, removal of inferior species and early thinnings. We read, however, that the Forest guards of the Deccan are employed in eradicating the prickly pear, which has become the most abundant species in many of the babul reserves. Some thinnings in the Kárwár casuarina plantation were made, but the area operated on is not given. In Sind, a Tali *(Dalbergia sissoo)* plantation, 90 acres in extent, planted out in 1876 and 1882 by Mr. Dasai near Sukkur, was thinned out, all crooked and useless trees and those growing too thickly being taken out, the yield being 23,025 cubic feet of locomotive fuel, 50 maunds ordinary fuel, and 77 cubic feet of timber in small scantlings, which is large, considering the age of the plantation, and the fact that merely the refuse was taken out and that the thinning did not make much appreciable difference in the plantation.

The outturn of the forests in volume of material has nowhere been given in a comprehensive manner, and the statements of the yield of the different divisions in kandis, cart-loads, donkey-loads, head-loads, &c., &c., is most confusing. Why cannot all these items be reduced to cubic feet for timber and firewood, and given in rupees for minor produce, for we quite fail to see the utility of the long complicated statements for the produce of the Northern and Southern Circles in an annual report.

In Sind, matters are simplified, but we find only timber given in cubic feet, and sleepers, posts and rafters figuring numerically, and firewood and charcoal in maunds.

The following remarks on the financial results of the three Circles are from the Government of India review :—

"The financial results as exhibited in the following Table show a general decrease, in the proportion of the surplus to the gross receipts, of 9 per cent. The proportion sank in the Northern Circle from 36 to 22 per cent., in the Southern Circle from 57 to 50 per cent., and remained steady in Sind.

Financial Results.

Circle.	Receipts.	Charges.	Surplus.	Proportion of Surplus to Receipts.
	Rs.	Rs.	Rs.	Per cent.
Northern, ...	9,13,099	7,10,002	2,03,097	22
Southern, ...	14,33,794	7,22,284	7,11,510	50
Sind, ...	6,85,783	5,17,704	1,68,079	25
Total in 1886-87, ..	30,32,676	19,49,990	10,82,686	36
Total in 1885-86, ..	33,66,286	18,39,461	15,26,825	45
Increase or decrease in 1886-87,	−3,33,610	+ 1,10,529	−4,44,139	−9

"The expenditure under A. (or Working Expenses) decreased in proportion with the fall in receipts, but the B. (or Establishment) expenses being regulated by other considerations, and therefore unelastic, caused the net surplus to decrease in a larger ratio than the gross receipts.

"The decrease in the gross receipts is accounted for by want of demand and low prices. It is possible that the revenue will recover, but there can be no doubt that the development of forest revenue in the Bombay Presidency is hampered by rights of user and privileges enjoyed by communities before the forests were reserved, and which it has been found necessary to recognise."

We give *in extenso* Mr. Shuttleworth's important remarks about the necessity for preventing the Bombay Harbour from silting.

"The drainage basin of Bombay harbour is to be found in the Thána and Kolába Collectorates, and it may be taken roughly at 1,500 square miles. The rainfall over this basin averages at least 100 inches in the twelve months; the greater portion of this rain, however, falls within a brief period of a few weeks. It would require a water tower of great dimensions having its four sides one mile long each way, and of the height of 2½ miles to hold this enormous volume of water. The erosive power of such a heavy concentrated rainfall precipitated from a great height must necessarily be of giant force. If then the steep slopes within the catchment whereupon this water is poured are not completely protected by superior vegetation to break the force of the falling rain and to let it down gently on to the ground, to retain the greater portion of it, and to bind the surface soil to the sides of the hills, the removal of earth from off their surfaces with its eventual deposition upon the lowest level, in this case in the harbour of Bombay, is the certain effect

of a present cause. One inch depth of soil taken off an acre of surface represents 3,600 cubic feet of earth, and one inch off 1,500 square miles of surface no less than 3,45,60,00,000 cubic feet; fortunately of the catchment basin made up very largely of hill and mountain slopes, a large proportion is still covered with trees, being included within "Reserved forests." Considerable tracts, however, of it being steep sloping ground are not within reservation, are under no protection whatever, and are exposed fully to the motive power of the rainfall, and the result may possibly be read in a letter which Mr. Russell Aitken, some time Engineer to the Port Trust of Bombay, addressed to 'The Times' newspaper of London last year, where the following sentence appears:— 'There was deep water in Bombay Harbour only where there was a rapid current to keep the channel open.' It has also been reported that large sums of money have been expended in the past few years in dredging silt out of the docks and harbour of Bombay. With the ever present examples of the silted up condition of the tidal channels of inland navigation of the Ratnágiri Collectorate, owing to the destruction of the forests upon their catchments, and of the Gulf of Cambay with the estuary of the Tápti river, the importance of extending forest reservation downwards to at least the base contour line of all the hilly lands, and of maintaining in the highest state of efficiency a complete covering of forest upon the slopes within the drainage basin of Bombay harbour, may not possibly be denied. The cost of obtaining occupied hill lands within the catchment basin would not probably exceed the amount spent during three or four years in dredging the harbour and the docks of Bombay."

The Government of Bombay disposes of this important question as one of important local interests conflicting with Mr. Shuttleworth's ideal scheme, but the Government of India will not have the matter thus shelved, and remarks as follows in its review :—

"Mr. Shuttleworth's remarks regarding the insufficiency of areas under forest in the catchment-area of the Bombay harbour and in the Deccan have been read with interest. No doubt the question of reservation in every direction has been carefully weighed by the Government of Bombay, and it appears certain that there is no further room for acquiring lands through a Forest Settlement. On the other hand, the action of monsoon rains on unprotected hill-sides is unquestionable, and the very possibility of silt collecting in the Bombay harbour, when such a contingency can be avoided, may, it is suggested, alter the balance of conflicting interests, and render the purchase of exposed hill-sides desirable. The Government of India in not in a position to judge whether the Conservator's fears are real or fanciful, but the opportunity of the Survey Department being in Thana might perhaps be taken advantage

of for the purpose of preparing a map of the Bombay harbour catchment-area, with contour lines showing all areas under permanent forest conservancy. It is observed that the Commissioner of the Northern Division strongly recommends the purchase of lands and rights on the crest of the Ghâts."

NOTES ON FOREST MANAGEMENT IN GERMANY.*

OUR readers are probably aware that our late Inspector General, Sir D. Brandis, is now in charge of the practical training of the Cooper's Hill Forest students. Ten second year's men are now with him in Germany, and have begun their tours by an inspection of some important and interesting forest works near Aix la Chapelle. The volume which we are now considering is an official paper drawn up to assist the students, and to put on record a series of notes made by the author in late years in the forests of the Grand Duchy of Baden, in Rhenish Prussia and other localities near the Rhine. The great defect of these notes is, as usual, their somewhat dry official style, but the want of maps is very marked, and especially so to those who have never wandered in the Black forest and explored the beautiful scenery of the valley of St. Blasien and the slopes of the Feldberg.

In an interesting preface Sir D. Brandis calls attention to some important points connected with forestry as a science, he points out how a Forest officer in India, 'if he is to do justice to his task, ought to be even more free from the prejudices of his special calling than Forest officers in other countries,' so that the effect of his measures on the well-being of the population both near and at a distance from the forests may be duly and rightly considered. And so he adds to his account of the Baden fir forests an account of the system of coppice combined with field crops which prevails in the Siegen District near Bonn, and which is only a properly developed and economical application of the familiar 'kumri' cultivation of India. In the Siegen forests, which consist almost entirely of pure oak coppice, worked on the system of 'coppice with standards,' an area of some 220 square miles is treated so as to give a periodical crop of grain as well as the wood and bark which results from the forest working. The rotation fixed for the simple coppice is about 17 to 20 years (19 on an average), and the 19th year when the coppice fellings are made, a crop of grain, usually

* By Sir Dietrich Brandis, K.C.I.E, PH.D., F.R.S.

rye, is obtained. It is, of course, the same system with which old French students are well acquainted, which is called 'sartage,' and practised in the French Ardennes, except that in France the rotation is usually longer, and the firing takes place over the whole area instead of in heaps between the coppice stools. The mean average annual yield in money of the Siegen forests amounts to, for 4,348 acres— .

	£	s.
Bark, per acre, ...	5	15
Wood ,, ...	2	15
Grain ,, ...	2	0
Straw ,, ...	1	5
Total, ...	11	15

and the account of the system of the Division of the produce among the proprietors is a very interesting one.

The greater part of the notes, however, refers to the fir forests of the Grand Duchy of Baden, and there is a good account of the system of forest management and of the physical features of the Black forest. Sir D. Brandis states that in the Baden State, out of 5,800 square miles 2,089 are forest, of which about 367 are the property of the State and the Crown. These State forests yield yearly a revenue of 21*s.* per acre on an average, and the charges are 10*s.* (not 8 as erroneously given), so that the net revenue yearly is 11*s.* per acre. In material the average annual yield is about 71½ cubic feet per acre.

The account of the physical features of the Black forest is very interesting, and the Madras official who recently propounded his theory that springs never rise on a hill-side, a theory which reminded us of those persons who periodically come forward and maintain the flatness of the earth, or that the sun is in the habit of moving round it, will be interested to learn that, though the higher regions present the feature of a table-land, springs are numerous where the gneiss prevails (as it does in Southern India), and especially so where granite is overlaid by red sandstone. Sir D. Brandis shows too, very well, how, as the pasture lands are not overstocked with cattle, waste lands with loose soil and stones are the exception, and the rivers carry little sand and silt. The chief tree is the spruce, especially at higher elevations, the silver fir predominating lower down, but the latter thrives very well, and often reaches a height of 150 feet. The whole of the forests in the St. Blasien area is treated in high forest, and the 'golden rule'

is observed that 'no new cutting shall be commenced, until, on the previous cuttings made in the immediate neighbourhood, the young growth has become fully established.' How this is carried out is explained in the notes, and it is worth while to extract further from the introductory chapter the important statement that "the character of modern forestry may be said to consist in this that each portion of the forest is treated with special regard to the peculiar conditions of the locality and the requirements of the growing stock, while due attention is constantly paid to the systematic arrangements of the entire forest range. The working plans prepared at the present time are elastic, and they are carefully framed to adapt themselves to the circumstances of the case." With this statement we are most thoroughly in accord, and we have been glad to find that in France also similar ideas are now much more gaining ground, and that professional knowledge and common sense are in future to supersede hard-and-fast prescriptions made possibly long periods before.

We wish to draw the attention of such of our readers as have trouble about grazing in their reserved forests to the provisions of the Baden Forest Law on the subject of pasture, given in Appendix I. The chief points of these provisions which we feel inclined to quote *in extenso* are that—(1), in high forest, pasture is not allowed till the young growth is 35 years old in deciduous, and 30 years old in coniferous, forest; (2), in coppice, 25 years for hard woods and 12 years for soft woods is the limit. Another noteworthy provision is that each head of horned cattle must be provided with a bell, and we wonder if any one has ever thought of this as a check in India. In another Appendix are some useful conversion tables, but we should have been better pleased if the author had done the conversions for us and used English measures throughout. And there is a most valuable and important glossary of technical terms, in the preparation of which we see that Sir D. Brandis had the advantage of the assistance of his successor in India, Dr. W. Schlich. This dictionary of German and English terms cannot fail to be of the greatest use to those officers who, though desirous of consulting German technical works, find themselves constantly stopped by hard words which are not to be found in ordinary dictionaries. We hope Sir D. Brandis will continue his notes, and they will then serve well as a guide to Forest officers who like to combine a little instruction with amusement on their furlough tours.

The Timber Market.

Messrs. CHURCHILL AND CO.'S WOOD CIRCULAR.

Dated 3rd August, 1888.

East Indian Teak.—A good month's business has been effected in this market at steady prices, the deliveries being 1,613 loads, against 762 loads last July, and making the quantity delivered since the beginning of the year 9,664 loads, against 6,690 loads for the same period of 1887. There is a considerable quantity afloat and chartered for, but what is unsold is still far off, and may well be absorbed by a constantly widening demand before it reaches this market. £8 to £13 per load.

Satinwood.—*East India.*—Stocks are too heavy, as although there has recently been more demand the consumption is very limited. 5*d.* to 8*d.* per superficial foot.

Ebony.—*Ceylon.*—Stocks are heavy and sales are only possible at very low prices, as the demand does not improve. *Mauritius.*—A parcel recently landed being of better sizes than old stock has been placed at very fair prices; only sizeable, good wood should be sent. £6 to £14 per ton.

Boxwood.—*Persian.*—There is a fair demand for sizeable sound wood. £5 to £12 per ton. *African.*—Small shipments of good wood could be placed at fair prices. £3 to £5 per ton.

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REPORT ON THE BETTER CONSERVANCY OF FORESTS ON HILLS SURROUNDING MOUNT ABU.

By BHAI SADHU SINGH, *Forest Ranger, Jeypore.*

GENERAL OBSERVATIONS.

Situation and configuration of Abu.—Mount Abu is situated near the centre of Serohi, a Native State, which forms the north-west portion of Rajputana. It is an isolated, precipitous granite mountain, with a good many steep peaks and ridges. The highest peak, named Guru Shikar, is 5,650 feet above the level of the sea. The elevation of Abu sanitarium is 5,000 feet. The circumference of the base of Abu is said to be 48 miles. The surrounding plains are generally open and level, though in places rather uneven and wild. The hilly tract to the east of Abu, as far as the Aravalli Range, named Bhakhar, is some 30 miles by 24 miles in extent, while towards the west, we see the much more level and cultivated plain.

Geology of Abu.—As regards the geology of Abu, the remarks of Mr. W. F. Eden will be found interesting: "The Mount Abu is not connected with the Aravallis, but is separated on the north by a few low hills, and on the east by the large plain of Rohera. It seems as if the mountain had originally been a series of peaks and ridges, separated by deep rocky defiles, which by the disintegration of the rock and the action of the elements had become filled up to a greater or less extent. For when wells are dug, it is not unfrequent to meet with clay, gravel, or rocks, more or less disintegrated as the workman passes downwards. Sometimes very fine specimens of rock crystals of large size are found. The vast mass of the hill is granitic, but occasionally within the boundary range of peaks, metamorphic trap, basalt and other varieties of the same gneiss may be recognized, as also other stratified transitionary rocks. On the eastern face of the hill the upper

parts are all granite, but as the plain of Rohera is approached, about one-third of the elevation inclines at an angle of about 75 degrees towards the horizon and dips downwards towards the west. On this face of the hill is also found a quarry of white marble, of which, it is said, the famous Jain temples on Abu were built. Earthquakes more or less marked are still frequent."

Soil, &c.—The soil being fertile and rich, is naturally covered with jungle in hills as well as to a great extent in the plains. But the peaks and ridges of the sanitarium have been nearly denuded, owing to the continued and indiscriminate cuttings that have been going on for the past 30 or 40 years, while in the plains the jungle is gradually diminishing to some extent, as the cultivation is increasing with the increasing population and the change in the mode of life. The inhabitants of the State now frequently come in contact with men from other provinces, and even with Europeans, whose number for visiting the Delwara temples, or Abu sanitarium is steadily increasing, and have been thus placed in a position in which their wants and aspirations are undoubtedly rising. Great facility having been afforded them for exporting ghí and minor forest produce, as well as grains, they pay particular attention to pasturage and agriculture. Thus the gradual diminution of jungle is certain, as is evident from the following facts, *viz.*, that the revenue of the State, which is mainly the land revenue, has increased from 1¼ to 1¾ lakhs during the past few years.

Rainfall, &c., at Abu during the last 15 *years.*

Year.	Average Barometer.			Average Thermometer.			Rainfall in the year.	Remarks.
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.		
							inches.	inches.
1870-71	25 94	25·72	25·83	84	54·	70	51·97	26·59 in July.
1871-72	25·875	25·648	25·776	78	61	69·7	56·38	29·69 in August.
1872-73	25·827	25·624	25·746	78	63	70	60·15	26·79 in ,,
1873-74	25·77	25·55	25·65	89·1	55·6	70·3	34·26	14·96 in July.
1874-75	25·80	25·5	25·7	84	55·5	68	72·29	28·17 in August
1875-76	25·70	25·64	25·67	78	61·4	69·6	110·30	50·90 in September.
1876-77	26·209	25·94	26 076	79·2	56·1	67·6	45·25	19·63 in July.
1877-78	26·134	26·046	26·096	79·8	62·37	71·09	19·29	5·06 in ,,
1878-79	26·107	26·046	26·075	78·8	71·7	70·4	72 79	33·52 in August.
1879-80	26·006	25·932	25·973	76·7	62	68·9	68·62	41·04 in ,,
1880-81	26·135	26·073	26·104	76·9	61·5	69·2	49·32	20·12 in ,,
1881-82	..	..	..	..	..	..	98·42	47·88 in July.
1882-83	25·952	25·887	25·919	76·92	62·1	68·81	58·58	38·12 in ,,
1883-84	25·956	25·989	26·174	76·5	61·5	68·6	52·95	25·18 in ,,
1884-85	26·041	26·078	26·114	74·6	59·6	66·8	105·36	41·96 in ,,

Rainfall in Abu hills.—The above statement shows that the rainfall on Abu is very uncertain—while in 1877-78 it was only 19·29 inches, in 1875-76 it was as much as 110·30 inches; the maximum of rainfall being in July and August. As a rule, March and April chiefly, January, February and October generally, November and December occasionally, and May, June, July and August are hardly ever without some rain. The uncertainty of rainfall on these hills affects agriculture in the plains to a considerable extent, as is evident from the fact of now and then, the crop getting remarkably short, fodder scarce, the grass scanty and the people suffering miserably in consequence.

Forest growth.—The forest growth varies according to elevation and soil. Along the foot of the hills, as well as in the plains, *Butea frondosa*, *Acacia Catechu*, *Acacia leucophlœa*, *A. rupestris*, *Prosopis spicigera*, &c., &c., are generally met with. But ascending further up we see *Ulmus integrifolia*, *Sapindus emarginatus*, *Ægle Marmelos*, bamboos, *Cratœva religiosa*, *Nauclea parvifolia*, *Sterculia urens*, *Boswellia thurifera*, *Diospyros Melanoxylon*, and some species of *Albizzia*, *Anogeissus*, *Zizyphus* and *Bauhinia*. Near the summit are found *Eugenia Jambos*, *Mangifera indica*, *Mallotus philippinensis*, *Cryptolepis*, *Buchanania*, *Casearia tomentosa*, *Anogeissus latifolia*, *Cæsalpinia Sepiaria*, *Ficus cordifolia*, *Flacourtia sapida*, *Ficus bengalensis*, *Ficus Wightiana*, *Ficus religiosa*, as well as *Dalbergia latifolia* and many others. Palm trees are confined to a few places only. As I stopped at Abu only for a short time and when the monsoons had commenced, a complete list of the species growing in the hills, with authentic local names, could not be prepared.

The inhabitants.—The inhabitants of Serohi are Bhils, Minas, Grassias, and Kolies, with Rajputs as their ruling race. The population of the State is said to be 55,000, or 18 persons per square mile. The plains of course are more populated than the mountains, as the facility for keeping herds of goats, sheep, and cattle, and that for cultivating land is more there than in the precipitous hills of Abu. The ryot is illiterate, uneducated and backward in civilization, consequently the majority of them are in poor circumstances.

Land tenure.—About three-fourths of the State is said to be in the possession of Rajput Thakurs, who give half the produce in kind to the Ráj; but I am told that the surrounding hills of Abu station are khalsa (or crown land), in which no Jagirdar, &c., has any right. These hills are principally inhabited by the Bhils.

Wealth of the people.—The wealth of the people chiefly con-

sists in flocks and herds. The villagers pay nothing for grazing or for fuel, timber or any other forest produce taken from their respective village lands, for *bonâ fide* household requirements. They can sell fuel by head-loads, free of all charges, but in case of fuel or timber removed for sale by carts, &c., they have to pay a certain rate to the State. Some of the minor forest produce, such as honey, is sold only to the Ráj at fixed rates. There is room in this direction for the people to extend their profits by paying more attention to the subject.

Mr. McKee, in the "Indian Forester" for October 1883, states that the revenue from *lac* in Rewah State has in recent years increased from Rs. 12,000 to Rs. 52,400, while formerly when the extraction of lac was not sufficiently known in Rewah it amounted from this source merely to Rs. 500 per annum. He adds that the people of Rewah are at present well acquainted with the process of extracting lac, and are thoroughly conversant with the habits of the insect, the method of propagation, and the treatment of the trees employed. He is of opinion that "Kala chilla," a variety of *Butea*, yields more lac than "Sufed chilla." Both of these varieties grow side by side in Rewah. Now there are a good many *Butea* trees here in Serohi, and an experiment is therefore worth trying to get lac from them. If the existing chilla does not give lac, the other kind of chilla may be introduced to good purpose. In Sawaie Madhopur of Jeypur State, gum is obtained by tapping the *Butea*. Similarly other experiments for obtaining minor forest produce may be tried in the interest of the State. In short, this subject is worth careful consideration.

Walar cultivation.—The jungle being valueless in the opinion of the people, a sort of forest-destroying cultivation is practised by them, notably by Grassias, a nomad tribe. They clear out large patches of forest land, and set fire to what they have recklessly cut down, without paying any regard to the useful trees, or the protective undergrowth. They use the ashes as a manure in their roughly prepared fields, in which they raise crops once, or twice, until the productive property of the soil is injured, the surface soil being either caked, or washed away, and the fields eventually turned into a mere scrub of weeds or bushes. The kind of cultivation above mentioned is called "*Walar*" in this locality, and requires gradual suppression, as it is neither profitable to the people nor the State. At any rate it requires every discouragement at Mount Abu, specially within some five miles of the sanitarium, where the Bhils are a little advanced in this respect, as they do not burn good trees for this purpose.

The wood supply of Abu station.—The fuel supply of Abu is chiefly by head-loads, mostly brought in by Bhils. The orders concerning this supply are, that nothing but dry wood should be brought in, but I have heard from trustworthy sources, that a great deal of green wood, principally underwood, is generally mixed with the dry, through want of careful supervision. The dry wood is allowed to be brought in from any place where it can be had, and wood being scarce near Abu, the Bhils generally bring it from a distance of two or three miles. Most of the local Bhils live by the fuel supply and sundry service to the visitors and residents of the sanitarium. Fuel and charcoal for Government troops are brought from the Nadra forest lands, situated on the western margin of Abu, outside the sanitarium. The supply is managed by a contractor. He purchases wood from the State, gets a portion made into charcoal by giving out petty contracts, and the charcoal as well as the wood he brings to the station by the same means.

REASONS FOR CONSERVANCY AT ABU.

Abu Sanitarium.—Abu is a place remarkable on account of the sanitarium for the Bombay troops and the head-quarters of the Rajputana Agency, as well as for the Lawrence School and the famous Jain temples, situated in Delwara, a part of the station. There is a small lake in the station, conveniently situated.

As far back as the year 1863, the population was only 1,200, but it has steadily increased since that time, and at present it is approximately estimated at 2,000 persons. The number of European gentlemen visiting the sanitarium has increased to about 60 per annum, and the number of native visitors, including pilgrims, to the renowned temples of the Jains, has increased during this period approximately from 1,500 to 8,000 per annum. The number of bungalows may be approximately put down at 100, with a larger number of quarters for servants and various petty houses in the bazaar. There are barracks for some 200 European soldiers. To meet the necessary demand for timber and firewood specially in a hill station, where constant repairs to buildings are necessary, and moreover a considerable quantity of fuel is required in the winter, the suppliers of wood have cut down trees indiscriminately during the last 30 or 40 years, wherever they could find them within a convenient distance. Consequently, the soil by heavy rains specially in steep places, has been considerably washed off, and the hard rock laid bare in many places. Thus the surrounding hills of Abu sanitarium have been almost denuded,

and the fuel and fodder supply fallen short, not to speak of the change in climate. Notwithstanding frequent injuries, a few trees with fair growth of underwood still remain. If this vegetation is for a certain period protected, even the steep and almost denuded rocks in the surrounding hills will, in time, recover. Besides these hills, the remote ridges and peaks of Abu hills are similarly steep and precipitous, consequently not suitable to extensive agricultural operations. The rain water falling on these steep hills of about 75 degrees, rushes down with great velocity, carrying down all disintegrated rock which comes in its course, flooding the ravines in the plain for a short time and then subsiding. As the banks of water-courses and streamlets, as well as the sides of the more remote hills, are fairly covered with forest vegetation, which breaks the force of the rainfall, and makes the rocks firm by means of its roots, the destructive torrents are prevented. This check in the course of torrents, is chiefly appreciated when we consider that the water being everywhere near the surface in the plains, and the soil being rich, as also there being a sufficient number of men in the State, there is every prospect for the extension of cultivation in the plains. As the country is now opened out by the railway, the increasing prosperity of the tenants will certainly provide them with necessary funds for extending agriculture. In short, to preserve the salubrious climate of the station, and to reduce the present high rates for fuel, fodder, and timber supply to the place, as well as to assist in the regularity of rainfall and to minimise sudden floods in the plains, it seems most desirable that the conservancy of forests on the hills in general, and that of the denuded ridges and peaks of the sanitarium in particular, should be brought under better management. An adequate area of forest outside the station, and conveniently situated for the purpose of supplying fuel and timber to the place, may be selected and placed under special treatment for the continuity of its produce. Besides this, the area extending to 300 yards on both sides of the main roads coming to the sanitarium may be specially protected to prevent landslips, as well as to afford agreeable cool air to the travellers who come to visit the station in summer.

PROPOSALS FOR THE BETTER CONSERVANCY AT ABU.

Proposals.—For the sake of convenience I have divided the proposals into four parts, *i.e.*, (*a*), those relative to the area within

the radius of 5 miles from the Abu church ; (*b*), those relative to the area extending to 300 yards on both sides of main roads to Abu sanitarium ; (*c*), those relative to an adequate area selected outside the Abu station with the view to supply fuel and timber ; (*d*), the area of the hills outside the above selected places.

(*a*). *Proposals relative to the area within the radius of 5 miles from the Church at Abu.*

Selection of Areas.—The fifth is perhaps the last mile where denudation has reached, but if operation to that distance be considered unnecessary, the limit may be put down to the fourth mile. Within this area, there are ridges and peaks which can be conveniently protected and brought under cultural operations. All such available ridges and peaks may be taken up where rights and privileges either do not exist, or can be easily compensated for, without much inconvenience to right-holders. Care may be taken that they are to some reasonable distance from habitable quarters. The plain portion of the plateau may be left out, as among other things, grazing lands for an adequate number of cattle to supply milk, &c., to the residents, is a necessity.

Demarcation.—The selected areas may be demarcated by kucha masonry pillars, conical in shape, 6 feet in diameter at the base, and 4 feet in height. Such pillars cost in the Murree forests of the Punjab only 8 annas each, white-washing inclusive. The average distance between these pillars ought to be quarter of a mile. They should be placed in conspicuous places, so that they may be clearly seen at a distance.

Fencing.—It is expected that the boundary lines of these selected areas will generally run along steep places, but in cases where cattle trespass is probable, rubble masonry walls, 3 feet high and 2 feet thick will be necessary. The average cost of such walls in Ajmere has been Rs. 2-4 per 100 running feet.

Sowings.—Sowings of indigenous trees may be extensively tried early in the rains. The seeds should be sown by dibbling them in contour lines in favourable places where good soil exists. The operations should commence from top side, gradually extending down to the base of the demarcated area. Seeds of foreign species should not be sown unless their cultivation and chances of success are well studied in a nursery.

Planting.—Planting is expensive, but to a limited extent attempts should be made to raise plants in nurseries near culturable areas for this purpose. The planting should generally be effected along the ridges, where the rush of water is not so severe as to wash them away.

Felling.—The hills under consideration are so much denuded, that fellings of any sort are as yet unadvisable. On the contrary, it may be recommended that even the removal of rank vegetation should not be allowed, as such vegetation binds the soil and prepares necessary humus for the rapid growth of seedlings.

Prohibitions.—The demarcated area should, as far as practicable, be closed against grazing till the new growth can admit of it with impunity. The prohibitory acts, which may be enforced are given here:—

(*a*). Breaking up waste land for cultivation without permission.

(*b*). Setting fire to grass, trees, or brushwood, or lighting or carrying fire in such a manner as to endanger the safety of the demarcated areas.

(*c*). Lopping, cutting, breaking or otherwise injuring trees or bushes or bamboos.

(*d*). Collecting any forest produce, such as gum, resin, honey, wax, &c., without permission.

(*e*). Digging or quarrying stones, kankar or limestones without permission.

(*f*). Cutting or grubbing grass, removing dry wood without permission.

(*g*). Grazing cattle without permission.

Gradual cultivation recommended.—It may be noted that extensive cultural operations are not recommended at once, but should be introduced gradually when necessary funds are available. The areas may be demarcated, even when the cultural operations cannot be undertaken for some time to come, and the proposed prohibitions enforced. The areas thus protected will become naturally regenerated, and in a few years the appearance of these hills will be remarkably improved.

(*b*). *Proposals relative to the area extending to 300 yards on both sides of main roads to Abu.*

Demarcation and Fencing.—Demarcation and fencing of this area are out of the question. The forest growth of this area can be protected by the same process as the road side trees in the plains.

Cultural operations.—Cultural operations are not necessary beyond casual pruning, as self reproduction as well as regeneration will be sufficient.

Prohibitions.—The following prohibitions may be enforced :—

1. Walar cultivation.
2. Lopping, cutting, breaking, or otherwise injuring trees, bushes, and bamboos.

3. Browsing by camels, goats, &c.
4. Digging or quarrying stones, &c.

(*c*). *Proposals relative to an area selected to supply fuel and timber.*

Selection of Area.—This area should be as near the station as possible, so that its produce may be brought to the sanitarium with facility. If possible it should be free of rights, specially those of grazing, or else the rights should be compensated for or regulated within reasonable limits. The extent of this area, of course, should be according to the requirements of the station. If one compact area is not securable two or three pieces might be arranged for.

Demarcation.—This area may be demarcated as noted above.

Fencing.—If necessary, the places where inroads of cattle are apprehended, may be fenced by kucha masonry walls, which are, though costly, but indispensable to secure the good-will of the adjoining cattle owners.

Natural reproduction to be encouraged.—Sowing and planting should be undertaken when absolutely necessary, and when the funds for the purpose have been provided. It is recommended that natural reproduction should chiefly be encouraged by means of selection fellings. This simple system consists in felling mature trees at convenient places. Care should be taken that the trees growing along water-courses, roads and water-sheds, are not felled, nor those where they are few here and there in open places, or where they are required for the purpose of shedding seed. The trees growing densely should be thinned out without much exposing the soil. Those proposed for felling may be marked with lime to enable the coolies to find them out. Care is also necessary that the crowns of the remaining trees are, as far as possible, either in contact with each other, or adjacent, so that the hot rays of the sun do not dry up the soil, for the seeds have more chance of germination and growth in moist and friable soil than in one exposed, or where the surface soil gets not only parched by the heat, but is washed away by the rains. Further care is necessary that deformed, twisted, sickly, or stunted trees are principally removed, except where their presence is absolutely essential.

Prohibitions.—The prohibitions mentioned above under (*b*) may be conveniently introduced.

(*d*). *Proposals for the area of the hills outside the above selected places.*

Demarcation and Fencing.—The demarcation and fencing of

this area is entirely out of the question, because the population is scanty, and the distant hills of Abu principally under forest growth.

Cultural operations.—Cultural operations are not necessary, as the demand of forest produce, except at Abu station, does not exist.

Fellings.—Green and good trees should not be allowed to be felled for sale at Abu, except when they are specially required for timber. Dead, deformed, or densely growing trees of good girth, not standing along water-courses, roads, or water-sheds, may be sold and felled if required. Dry fallen wood may be conveyed to the station either free of charge, or on payment of some prescribed fees, as may be decided by the Raj. The privileges or rights of the people should of course be respected, but if any scheme can be devised to make them understand that the removal of trees from the banks of water-courses, sides of roads, or water-sheds, are injurious to forest conservancy, this would be highly commendable.

Prohibitions.—The only prohibitions required at present are, that "walar cultivation" be discouraged as far as possible in these hills. Browsing by goats, &c., requires regulation. These animals should only be allowed where their prohibition seriously affects the rights or privileges, and a suitable fee may be imposed on goats, &c., which are kept there for trade, so that this practice may be confined to the plains alone.

Demarcated areas may be named "Forest Reserves."—If advisable, the demarcated areas may be termed "Forest Reserves," and numbered consecutively, as well as distinguished by some local names.

Permanent Nursery.—For the purpose of raising delicate seedlings, as well as studying the growth of foreign species, it is necessary that a small permanent nursery, of about an acre or two in area, may be prepared in a convenient place where watering can be arranged without much expense. Perhaps a site near Delwara or Abu lake will be found suitable.

Fire-protection.—Among the chief enemies of forest conservancy, forest fires occupy a prominent place. They destroy in a short time what efficient protection and repeated cultural operations have produced in several years. Elaborate proposals for keeping out fire are uncalled for at present. However, the demarcated areas may be divided into blocks by fire lines, which should be kept clear of grass, &c., when it is dry. In other places of the hills conflagration should be discouraged as much as possible.

Prohibitions.—For the better protection of demarcated forests,

it is essential to frame and put into practice some prohibitions of acts likely to damage them. They are summarised in a previous page ; but it is as well to explain the reasons here as follows :—

(*a*). This section is necessary to check walar cultivation, which is destructive of forests, as well as to prevent people from disposing of valuable forest produce under the pretence of clearing forest land for cultivation. Moreover, when there is ample room for cultivation outside the forest, it is quite superfluous to encroach upon the forest area set aside for well considered purposes.

(*b*). As grass and dry wood are not removed, the chance of fire breaking out becomes all the greater, hence urgent necessity for the prohibition.

(*c*). The simple reason for prohibiting the practice of lopping, &c., is that the standing growth is seriously injured thereby, and future regeneration rendered valueless.

(*d*). The prohibition against the indiscriminate collection of gum, &c., is evidently necessary, as it is generally observed that the persons gathering such articles do not, in the least, mind what great injury they invariably inflict upon the body of some of the valuable trees.

(*e*). With regard to quarrying of stones, &c., it may be observed that people, by their indiscriminate operations in some places, undermine the base of valuable trees, in other cases, cause landslips that result in obstructing the water-courses, damaging the roads and destroying surfaces previously covered with good vegetation. Hence it becomes necessary to prescribe particular spots for quarrying, after careful consideration of the various circumstances.

(*f*). The careless cutting of grass takes away with it many hopeful seedlings, while the survivors remain exposed to the inclemency of weather. Moreover, by this practice, materials of useful manure, are lost sometimes in places where their service is absolutely necessary for the rapid regeneration of denuded areas. The dry wood is similarly useful for enriching the soil.

(*g*). With respect to grazing, it may be pointed out that browsing animals, *viz.*, camels, goats, and sheep do great damage to the plants by eating off all their delicate parts and materially effecting their growth, while animals that simply graze are so far injurious, that they disturb the soil, and thereby damage the young growth. Hence browsing requires to be strictly prohibited, while grazing cannot be allowed without well considering the tracts in which it is likely to do the least injury.

Procedure of preventing forest offences.—With regard to the above prohibitions, as well as those that have been elsewhere mentioned, the procedure to be adopted for carrying them out may be conveniently left for the consideration of the local officials. But one point in connection with the subject is worth noting down, *viz.*, that, as far as possible, preventive measures are to be invariably preferred to direct punishments, &c.

Establishment.—The demarcated hills surrounding the sanitarium, and the area selected for the supply of forest produce to the station, require special establishment for carrying out various works and protecting the forest growth, while the protection of the area, extending to 300 yards on both sides of the main roads, can be conveniently left to the officials in charge of such roads. The forests in the hills outside the above noted places can be managed by the local revenue officials of the State, subject to the professional advice of the forest official in charge of demarcated areas. This official should be a qualified forester, otherwise efficient treatment of the forests cannot be expected. If available, one of the State officials, or a student of Serohi School, should be trained in the Forest School of Dehra Dún, or the services of a trained man may be secured. The strength of forest establishment will, of course, depend upon the areas selected and efficiency of protection required.

Revenue and Expenditure.—To defray the necessary expenses of reboisement, as well as maintenance of forest establishment, it is necessary that adequate funds should be provided. In Murree a sanitarium of the Punjab, such funds are set aside out of the income derived from forest produce consumed at the place. Permits are issued by the Municipality or Forest Department for dry wood and grass removed from lands under their respective jurisdictions. Available standing trees are either sold by public auction, or on application of traders at prescribed rates. Annual contracts are given for the supply of forest produce to the Government troops. A depôt for the supply of charcoal to the residents at fixed rates is maintained by Forest Department. As a rule, the site, method, and time for cutting or removing forest produce are prescribed in the permits, &c. If similar procedure be gradually introduced at Abu, the necessary provision will, in time, be obtained, but to initiate the conservancy arrangements, it is necessary that the State may provide some money before the Department can be self-supporting.

JEYPORE,
5th October, 1886. } SADHU SINGH.

ANNUAL MEETING OF THE AMERICAN FORESTRY CONGRESS.

(*Continued from page* 458).

SECOND DAY'S PROCEEDINGS—(*concluded*).

Prof. J. L. Budd, of the Iowa Board of Forestry, read the following interesting paper :—

Possible modification of our prairie climate.

Mr. President :—I think it was not wise to promise a brief paper on this disputed subject, as I believe—in common with most of our early prairie settlers—that an appreciable change of climate has been wrought by the occupation and cultivation of the prairies by civilized man, and that an extended system of forestry planting in great blocks, such as is common in all parts of continental Europe, might change our present climate for the better in a brief period.

On the other hand our American physicists seem to unite in accepting the sweeping assertion of Prof. Elias Loomis, and others, that the mean temperature and rainfall for given periods does not vary sensibly from century to century, and that there is no evidence whatever that the earth's climate has changed materially in 2,000 years.

While I do not feel like combating this general proposition from the standpoint of *periodic averages of temperature and rainfall*, I am anxious to impress the fact that successful orcharding, small-fruit growing, and crop production in field and garden, *depend more* on *extremes of rainfall, temperature and atmospheric humidity* than on monthly, annual or longer periodic means.

Especially is this true of great area of prairie or steppe, far removed from the breadth of the ocean, such as our great western plains, and the still greater steppes of Europe and Central Asia.

In continental Europe the methodic and general forestry system is founded and sustained on the generally accepted belief that a judicious distribution of large forest areas will modify diurnal variations of temperature and moisture of air during the growing season, and possibly will bring about a more equal distribution of rainfall if it does not actually increase it.

The general plan of the meteorological observations in Europe will give, and has given during the past century, much precise information on this vitally important subject.

The learned Secretary of the London Meteorological Society gave us in 1882 the following guiding principles, observed at the meteorological stations of continental Europe.

(1). Ordinary meteorological tables of periodic means are not sufficiently detailed to throw light on the influence of the weather on agricultural or horticultural crops.

(2). To be truly valuable, the observations must be frequent and accurate, and give daily and monthly *extremes* as well as *means*.

(3). For agricultural purposes, the heat should be observed in the open sunshine, as field crops can have no protection from direct sun heat, or the heat of the lower beds of air on exposed soils.

(4). The temperature and humidity of air during the heated portions of each day, in the growing season, and their extremes, should be recorded.

(5). We need more perfect heat measures than we now have. That the sun reached a certain temperature at a certain hour gives no correct idea of the sum total of heat during the day.

(6). We need more perfect observations on relative evaporation under the varied conditions as to exposure, colour of soil, protection from wind sweep, &c. The evaporation from a tin dish on a grass plot gives no correct idea from the evaporation from exposed dark coloured soils.

Had we been favoured with such accurate observations on our daily, monthly and annual extremes of temperature, humidity of air and rainfall at varied points over our prairies for the past 40 years, we would now be able to give scientific reasons why spring wheat is now a precarious crop on virgin sods, why rusts, smuts and blights are more general than in the early days, and why orchard trees, shrubs, &c., that succeeded perfectly 30 years ago, now utterly fail to endure our summers or winters.

As our relatively new country cannot give this accurate information we can only talk of *probable* causes for *known* effects.

(1). We have reason to believe that our winds from the south-west, west and north-west are hotter and drier in summer than 40 or even 20 years ago, and that our winds from the Gulf of Mexico have not materially changed as to heat or contained moisture. If well founded this would account for many of our cumulative troubles in crop production. Prof. Tyndall has remarked that a change in the extremes of heat, cold, moisture and aridity of air, of *five per cent.* may change or materially affect the field crops of a whole country. In Europe, Asia, and in our American States at the east and south, the destruction of the native covering of timber has wrought the changes which the statement of Tyndall predicted.

In the prairie region we have as much timber to-day—perhaps more—than we possessed when the first settlers put up their cabins on the borders of the island groves and the stream timber borders of Indian and Illinois. Yet it must be said that the prairie groves, and the timber of the stream bottoms and adjacent bluffs, then presented *real forestry*

conditions, which alone can modify climate to any noticeable extent. *Now*, our larger timber areas are broken by clearings into little patches and our planted timber is in little patches and thin belts for arresting wind sweep. In the way of arresting too rapid evaporation such timber planting is useful, but it cannot take place, in climatic modification of the scattered areas of *real* forests known to the early settlers. But the *main* cause of the cumulative increase of heat and aridity of our westerly winds in summer, is given with special clearness by our lamented Arthur Bryant on the first page of his valuable work on Forestry. In this brief paper we cannot repeat the whole story, nor is it needed in this body of clear thinkers and close observers. Forty to 50 years ago the whole prairie region, west of Lake Michigan, was literally *a sea of grass*, interspersed with island timber belts and groves, clogged drainage centres, and wet bottom lands without visible outlet. Even in the famously dry summer of 1854 the flats, drainage centres and sloughs of Illinois, in Dekalb county—which are now dry and firm—would *mire a team* in August, while the grass could be tied over your hat when sitting on a horse.

The whole country was then in condition to hold the never-failing June freshets, and as Bryant states, the rank vegetation of forest, barren timber lands, and open prairie took the place of the forestry covering of the eastern and middle States to a measurable extent. Even then the rainfall was variable, ranging for instance from 74½ inches in 1851 to 23½ inches in 1854, yet it was proverbial that the dry seasons *then* gave the best crops and the fattest hogs and steers. The driest and hottest winds from the south-west were then never known to "fire" corn, to burn the leaves of trees or plants, or to prevent the deposit of copious dews at night. Forty years ago Robert Russell said that continued westerly wind could never fail to bring drought to the prairie region, yet the continued westerly winds of 1854 and 1855 did not come to us as now robbed of moisture, and as dry and hot as the air from the Sahara Desert.

The grassy plains and clogged sloughs and streams *gave off moisture to the passing breeze*. At this time the whole west presents a different aspect. Since Bryant wrote in 1870, the evils of which he complained have become more pronounced. Literally a great expanse of country—large enough to make several kingdoms of Europe—in the west and north-west—have been since turned with the plough, with the accompanying drainage of sloughs, ponds and streams. Our winds from all westerly points now literally pass over *a dry heated soil* in a dry period, which drinks up with hungry avidity the moisture of the air.

For the benefit of those who may doubt that the occupation by man of a prairie country, with the consequent exposure of an alluvial drift soil by culture, pasturage, cities, villages, roads, railway beds, drainage, opening of clogged and boggy drainage centres, and creek channels, &c., will increase the heat and aridity of the breeze passing over it, we might

give many pages of proof from the chequered history of the great eastern plain of Europe and Asia. In the light of this experience we might reasonably expect a more radical and positive change of climate than we now complain of.

(2). The tendency to long continued westerly winds during our dry periods has seemed to increase during the past 40 years.

After careful consideration this seems quite as probable as the increase of heat and aridity of our summer air.

It may be said that we are on the plain at the foot of a mountain range. West of the Missouri river we ascend an inclined plane to Denver, where we reach an altitude nearly one mile above the bed of the Missouri or the Mississippi.

Just west of Denver we reach the apex of elevation on the summit of the Rockies. The natural movement of cool air from the mountains down the elevated plane to our relatively warm valley, was a marked peculiarity of our climate when the buffalo and Indian roamed over our prairies.

That this natural tendency would be increased by any marked increase of heat and aridity of our summer air in the Mississippi Valley, *is too evident* for words. In connection, it should be kept in mind that the inflow of air from the elevated plateau and mountains west of us is really *only a continuation* of the natural current that flows inland from the Pacific ocean to the summit of the Rockies during the heated term. When the cañons, gorges and slopes of the mountains east of the summit were covered with a dense growth of conifers, that held the snows well through summer, the Pacific moisture was mainly precipitated *on the range and its foot-hills.* But more recently the heating of the rocks, consequent upon the removal, in large part, of the timber covering by fire and axe, permits a greater per cent. of the Pacific moisture to pass through the gaps and over the dry plains of Colorado to the eastward. Plainly this moisture might pass eastward to the Alleghanies if it failed to meet cooler northerly currents, as it often does in the valley of the Missouri and south of the great lakes.

From this source, beyond reasonable doubt, has come the blessed showers which gave 11 inches of rainfall to the west slope of Iowa last June, while east of the divide we had, during the same period, but two inches, and that in light sprinkles.

We can only add that our idea, that we have had almost continued westerly winds during the severely dry summers of 1886 and 1887, has been disputed on the grounds that we have had winds from all directions, *often changing three or four times a day.* Our close observers need not be told that the variation of our surface winds, in connection with indications of rain, have always been followed by the steady inflow of air from the dry west.

(3). While our average rainfall of summer for a period of ten years may about equal that of the period from 1850 to 1860, it seems to be less equally distributed through the season of growth and the wet and dry seasons.

On this point Mr. Bryant says:—"Extremes of wet and dry weather are more frequent, and the dews condensed in dry seasons are more scanty. Instead of abundant rains in May and June, dry weather at that season is more common."

As to causes, we can only look to the changes wrought by man on the prairies and mountains west of us as already indicated. With the approach of cold weather each year we have a change in prevailing winds and character of storm centre. The snow covered Rockies become storm breeders, from which will pass eastward our usual series of storms and blizzards. In the early spring, if we have our usual supply of melted snow and heavy rainfalls, filling our bottom lands of rivers and streams and making it difficult for farmers to get in their crops, the lower levels of our plain become *less heated, and we may have until July* an alternating play of winds up and down our valley from the Gulf of Mexico to the polar ocean, bringing an excessive supply of the blessed rain, but facts too evident for successful refutation lead us to believe that the tendency to *extremes of drought* will become still more manifest as the prairies become more generally occupied and cultivated, unless, as Bryant says, the evils we have brought about be not mitigated or perhaps wholly removed by planting a due proportion of the country with forest trees.

This brings us to the consideration of the question; in the light of the experience of the old world, as indicated by Geo. P. Marsh in his able work on "Earth as modified by human action," what course should Congress have pursued in the disposition of public lands in the northwest.

During a talk with Lewis Ellsworth and Dr. John A. Kennicott, in the old Prairie Farmer office in 1857, they unitedly expressed the belief that at least 30 per cent. of the whole prairie area then in the hands of Government *should be reserved for timber planting in great blocks*, as practiced in Europe, and that a large share of the proceeds of sales of the remaining lands should be devoted to the systematic planting and after care of the reserved tracts, I think it will be generally agreed that this methodic disposition of our prairie lands would have been immeasureably better than frittering away the proceeds of the land in harbour improvement and abortive attempts to make mud creeks navigable.

We pass over the final attempt of Congress to do something for the forestry interests, as the plan of securing a timber claim by the planting of ten acres of timber could not materially modify our climate, had each settler under this act *faithfully carried out the contract.*

Even at this late date Congress could do much by withdrawing from

market large tracts on the western plains, and on the headwaters of our streams in the west and north-west, with a view to systematic timber planting and the preservation of that we now have in the Rockies, *but that it will be done*, we are not more certain than was Dr. Kennicott and Mr. Ellsworth in the early days of prairie settlement. I will only add that my faith in methodic forestry planting as a complete or partial remedy for the climatic troubles we now experience, is much stronger than it was in 1881. During the summer of 1882, I was permitted to study critically the elaborate forestry system of the Russian Empire in Europe. Prior to the time of Peter the Great we have the most complete evidence that a very large part of the black soil region east of the Volga was subject to periodic extremes of rainfall, followed by long continued drought, during which the moisture-bearing winds from the west passed over the heated plains of Russia in Europe and Central Asia to the far off Altia range of mountains without precipitation, as they now pass over Western Texas and Southern California. *Now*, the planted forests on these steppes are 12,502 in number, which are under the general supervision of 762 educated Directors.

The area of these individual forests ranges from 3,000 to 30,000 acres.

In company with forestry experts we passed through many of these island forests on the great plain, and found everywhere an attempt to preserve *real forestry conditions* by thickness of planting, the preservation of underbrush in open parts, and the rigid exclusion of fires and stock. In all cases we found the dense sylvan shades, and the carpeting of leaves and leaf mould which keep the earth cool and moist.

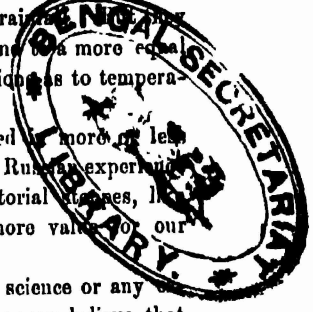
As to climatic effect, the Minister of Public Domain assured us that the meteorological records of past 150 years, and the reported crop yields on the steppes dotted with these forests, had shown a cumulative increase of rainfall from summer showers, and a decided increase in the moisture of the air during the growing season.

He was also positive in the statement that the modifying influence had extended into the eastern sections, with the completion of the forests, where formerly the lands had been utterly worthless except for thin and scanty pasturage.

In the earlier history of this region the main rainfalls were in June, but since the completion of the forestry system—now covering fully 30 per cent. of the black soil area—the summer showers during July and August permit the successful culture of the sugar beet, potatoes, Indian corn and other crops requiring rainfall later than June. When questioned for the causes for the increased summer rainfall, the invariable reply of experts was, that it resulted from the *unequal heating of the air* over the plain, brought about by the large forest areas.

On the north plain of Europe, including North France, Belgium, Holland, North Germany, Denmark, Prussia and Poland, we found a methodic

system of forestry planting and preservation, and that all classes from peasant to prince united in the belief that 33⅓ per cent. of the country must be kept in timber, yet we did not here find scientific men united in the belief that forestry planting directly increased rainfall, they did unite in the belief that large areas of forest tended to a more equal distribution of the rainfall, and more equable conditions as to temperature and humidity of the air.



On the north plain of Europe forests have existed in more or less perfect condition during hundreds of years, hence the Russian experiments in the way of extended timber planting on bare pastorial tracts, like our plains west of the Missouri to Denver, has more value for our guidance.

As nearly as we can believe any proposition of science or any established principle growing out of long experience, we may believe that the Russian plan of great island groves over our western prairies will give us a more equal rainfall and more equable conditions as to summer humidity and temperature of air.

With a despotic form of government we might hope to try the scheme in the near future, but left to the voice of the people the time of trial seems far off. Permit me to repeat the opening remark that it is up hill work to write in a satisfactory way on a subject on which I know so little, or on which so little is generally known *as prairie climatology*.

It would have been far easier to talk of species and modes and methods of planting *the blessed timber* in which *I believe with an intensity bordering on perfect faith*, as our final saviour and preserver from climatic ills and evils which each year are becoming more apparent.

"The influence of the Western Treeless Plains on the Atmospheric conditions eastward of them," was the subject of a paper read by Dr. Dan Berry, of Currin, Ill., at the opening of the evening session. It was an elaborate production, and proved the author thoroughly informed on the subject of air currents and the causes which influence their course. The fact that the once verdure-clad western plains were yearly reduced to ploughed ground, the further fact that the forests of the west and south-west and of the mountains were almost obliterated, explained to his mind the increased dryness from year to year of the air currents that sweep over the Mississippi valley. These currents are now dry and arid instead of moisture-laden as formerly. Again, tiling throughout the west rapidly carries off the rainfall to the rivers, from whence it flows in freshets to the sea, without, as formerly, remaining in the ground to become a source of vapour and clouds. The planting of forests at regular intervals throughout the west is the only remedy.

The paper was discussed by Messrs. Fernow, Robertson, Allen, and others, and the author's views generally endorsed, Mr. Allen particularly urging the building of dams and fish ponds throughout the country as receptacles for the water that escapes through the tile.

Mr. S. C. Robb, Kansas State Forest Commissioner, read a paper on "The Status of Artificial Forest Planting in Kansas." He stated that in Kansas, in what was once called the "Great American Desert," there were now many groves of flourishing trees from six to eight years of age. The planting of these was attributable principally to the "timber culture" law passed years ago by Congress. The timber planted in this way already aggregated many thousands of acres. Again, in Kansas tree planting had been practised to such an extent that many of her towns and cities give the appearance of large forests. A law had been passed by the State under which a "State Forest Commissioner" had been appointed, and experimental forest stations established. From all this the most flattering results were being yearly realized.

The paper was discussed at length by various members. The author having in the course of his paper incidentally mentioned the prevalent belief that the American Forestry Congress was opposed to the timber culture law, Mr. Fernow emphatically denied the correctness of that impression. The Congress, he said, at all its sessions had invariably refused to take any action whatever on the subject—either to commend or criticise the Timber Culture Act.

"Tree Planting on Prairies" was a paper read by Hon. David A. Brown, of Bates, Ill. It cited instances where black walnut and other trees had been planted on Illinois prairies with great success. He favoured the planting by Illinois farmers of double rows of trees around the limits of their farms.

T. J. Burrill, of the Champaign (Ill.) Industrial University, spoke ten minutes on experimental forestry as practised at the University. In 1871, the planting of forest trees was begun at the University. Twenty-five varieties were planted. Most of these are now in a thrifty condition, although the land on which they were planted was prairie that had been under cultivation for 30 years. Many of the faster-growing trees are now 40 feet in height and 2 feet in circumference.

After brief discussion of Mr. Burrill's remarks, the Congress adjourned temporarily.

BEETLE DESTRUCTIVE TO SAL COPPICE SHOOTS.

I HAVE noted, as stated in some of my reports to Government, that the succulent shoots of coppice sál saplings were ringed by some insects, in the rains, because the marks left in October—November, showed that they were comparatively recent, and the dead upper portions showed that the leaves had reached maturity ; it was probable also that the ringing was done by flying insects, as the tops of the shoots (within a foot or two of the top) were the parts usually affected.

As the ringing of the bark, and the consequent destruction of the portions of the stem above it, render the coppice shoots liable to be crooked or to bifurcate, I desired, if possible, that the insect might be discovered. The insect which, from Mr. Thompson's report, I believe to be a species of *Monochamus*, of the family *Longicornes* (Capricorn beetles), order *Coleoptera* (beetles) of Baron Cuvier.* The insect was found at work in the evening (so reports the Forester), and a specimen of the ringing was also sent. It is probable that the insects use the soft bark for their own food, but the quantity used seems to me so large compared to the size of the insect, the bark removed from one stem being of greater weight than the insect itself, and nearly every coppiced stem is thus ringed, that it seems to me just possible, that this species of monochamus prepares a larger ball of masticated succulent bark to deposit its eggs in, as is done somewhat similarly in the case of the common dung beetle, as it is hardly probable that this beetle commenced its attacks in the pupa state in the unhealthy tree, and finishes them when in the complete state by damaging the health of the tree. The horns are not long enough for *Cerambyx vatica* (Plate VIII., figures 13 and 14, larvæ 15 and 16) or sál beetle of the same family, the larvæ of which are found in dead or decaying sál.

E. WOOD, *Captain,*
Conservator of Forests, Oudh.

IN anticipation of the specimens being precisely determined, we may notice that the insect sent by Captain Wood, and described above, has the same habits as the American "Hickory twig girder" (*Oncideres cingulatus*), which also belongs to the cerambycidæ.

In the case of the Hickory twig girder, the mother beetle deposits her eggs in notches, which she cuts in the bark of hickory

* Plate VIII., figures 1 and 2, but rather longer I think.

branches, and then proceeds to gnaw a groove around the branch just below where the eggs are deposited; so that the terminal portion of the branch dies, and the larvæ, on emerging from the eggs, feed on the dead wood.

It is well known that all cerambycid beetles prefer to lay their eggs in trees which are in an unhealthy condition, and also that trees killed by the artificial girding of their stems are peculiarly subject to attack: the most probable explanation being that the copious flow of sap in a healthy tree is prejudicial to the life of the boring grub. We see, therefore, that the girder beetle only reproduces on a small scale the conditions which, when they occur accidentally, are peculiarly well suited to the development of its larvæ.

As the eggs are deposited beyond the groove, the most effectual preventive measure is obviously to collect and burn all the withered portions, so as to destroy the grubs. In the case of the American species, it has been found that the groove generally weakens the branch to such an extent as to cause it to break off and fall to the ground with the first wind, hence the systematic burning of all wind-fallen branches is sufficient to check the evil. It would seem worth while therefore to ascertain whether the groove made by the Indian species has the same effect, and on this to a certain extent would depend the practicability of preventing similar damage in future years.

DEHRA DUN, E. C. COTES.

13*th October*, 1888.

INACCURATE ACCOUNT OF INDIAN WOODS.

I HAVE just come across an extract from the 'Indian Engineer' republished by the 'Madras Mail,' and cannot help writing to draw your attention to it. Surely the time has now come, with the publication of Floras and Manuals and Dictionaries of Indian Economic Products, for something better than this, which reads like a return to the days of Balfour's 'Timber Trees' and similar publications which, though they undoubtedly were in their day, of the greatest value and help, are now considerably behind the age. Surely better than this might have been expected from a writer so well-known for his most useful Timber Tables, and so eminent an Engineer, as the late Mr. Kunhya Lall, Rai Bahadur, and one cannot help thinking that the paper published under his name must have been written years ago, but never published, and that he himself would not have approved of its publication. A

few glances at Brandis' 'Forest Flora' would have saved the paper from many inaccuracies. What can be more absurd than to speak of "the bamboo (*Bambusa arundinacea*)" as if there were but one bamboo in India, and as if, if the chief one were intended, the universally found *Dendrocalamus strictus* would not have been chosen in preference as a type. Again, *Diospyros Ebenaster* (an old species of Roxburgh's now merged in *D. Ebenum*) is not *the* Indian ebony, so much as the more common *D. Melanoxylon*. *D. Ebenum* only occurs in the south of the Madras Presidency, and even there is by no means common, and by no means in general use for cart axles. Again, the 'shisham' of the Punjab, which is used for furniture in that Province, is not *Dalbergia latifolia* (which is the blackwood), but *D. Sissoo*, and so on, as any Forest officer will at once see, but the extract reads more like a school boy's essay than a description intended to be useful to Engineers. And the woods mentioned are not all really timber woods, for who among us has heard of the use of ebony or tamarind in engineering? Trusting you will excuse my drawing your attention to this slipshod way of treating an important subject.

M. K. M. B.

THE STATUS OF FOREST RANGERS.

With reference to the notification of the Government of N.-W. Provinces and Oudh of 19th March, 1887, directing that Forest Rangers hold the same status as the Inspectors of Police do, the question arises whether Forest Rangers are allowed seats in the Durbar, when it takes place within their jurisdiction, in the same way as Inspectors of Police, it is presumed, are allowed.

Do the District Forest Officers in Berar get seats in the local Durbar when it takes place in their jurisdiction? Information on these points, through the "Indian Forester," will much oblige.

S. S.

In reply to the above enquiry, it is noted that the Government of the N.-W. Provinces has ruled that Forest Rangers, 1st grade, rank next to Inspectors of Police, 1st grade, and above Inspectors, 2nd grade, and that Forest Rangers, 2nd grade, rank above Inspectors, 3rd grade, and so on.

All Forest Rangers are clearly entitled to a seat in Durbar.

The following copy of Circular, No. 19F., dated Simla, the 26th July, 1888, of the Government of India, Revenue and Agricultural Department (Forests), gives the opinions of the Government of India on this subject:—

After consideration of the replies to the Circular of 7th May, 1887, the Government of India is of opinion that it will be desirable to leave it to Local Governments and Administrations to pass such orders as they may deem expedient in regard to the question of local precedence between Forest Rangers and other classes of public officials. At the same time, the Government of India is disposed to concur in the view of the matter taken by the Government of the Punjab, *viz.*, that Rangers should be conceded the privilege of a chair when visiting European officers, and that, if of a certain standing, they should be entitled to admission to Provincial Durbars held in the District or Revenue Division in which they are employed.

It is clear, therefore, that the Government of Berar can pass such orders regulating the position of Rangers as it considers advisable, and that Government would doubtless not wish its Rangers to have a lower status than those of other provinces.—[ED.]

DENDROMETERS.

IN the July number of the "Forester" a question is raised with regard to the accuracy of Weisse's dendrometer, and the advantages of Faustmann's instrument are stated.

I formerly used a Faustmann and now use a Weisse, which I prefer to the former for the following reasons:—

1*st.* It is made of brass and white metal, and is not therefore so liable to injury from heat and moisture. It could be used in the rains in Burma, when an instrument of wood and paper could not be used.

2*nd.* The plummet is heavier than that of Faustmann's instrument, which is of great advantage, especially when a strong wind is blowing.

3*rd.* There are nineteen teeth to the inch, and the instrument is therefore on a larger scale than that of Faustmann.

Both instruments are the same in principle, and there should be no difference as regards accuracy, if both are tested under most favourable conditions; but under unfavourable conditions (high wind), I am of opinion that Weisse's dendrometer would give better results.

Weisse's instrument is less portable, measuring in its case 9" × 2¼" × 1½", and is more expensive.

In my instrument the alternate teeth are marked 1, 2, 3, 4, &c. For measurement in feet, it would be more convenient if the alternate teeth were marked 2, 4, 6, 8, &c., and if any Forest officer should order a dendrometer, I would advise him to have it marked in this way.

P. J. C.

FORESTRY IN A NATIVE STATE.

It is heard from a trustworthy source that His Highness the Rajah of Nabha in the Punjab, has appointed three men on Rs. 20 each a month, and has posted them to each of his three nizamats. These men are placed in charge of nurseries, which are started at convenient places. Their work is supervised by one Superintendent, posted at head-quarters of the State. The pay of the Superintendent is Rs. 60 a month. It is contemplated by His Highness that all the village boundaries of his 600 villages should be planted with trees, so that the boundary disputes should not arise by the zemindars.

If this policy of utilizing the service of trees on boundary lines be considered and discussed in the pages of the "Indian Forester," I think forestry can add one more advantage to itself. If the move of His Highness is in the right direction, surely this subject can be brought to the notice of District authorities, and some means of introducing this system in British India may be devised.

S. S.

Owing chiefly to the enterprise of several traders, the fiftieth year of Queen Victoria's reign is likely to be well impressed on our memories, the word Jubilee having been attached to goods of the most opposite descriptions. Mr. Asshton Smith is determined that the event shall be recorded in a very prominent way. He has caused to be planted on the side of a mountain in Wales, Moel Rhimen by name, a plantation of nearly seven thousand trees, which will be so arranged as to represent the words 'Jubilee, 1887.' The letters each measure two hundred yards long, by twenty-five feet wide; and two hundred men, it is said, have found constant employment in planting the trees since Jubilee day, when the work was commenced.—*Chambers' Journal.*

JJ. Reviews.

FORESTRY IN MADRAS.*

Forestry in Madras is still to a large extent confined to selection and settlement of the State forests, and 684 square miles have been added to the area of the reserved forests during the year under review, raising the area to 2,312 square miles, whilst the area of reserved lands was 7,984 square miles at the close of the year, the settlement having been effected over 1,000 square miles more.

It is estimated that the area to be eventually reserved in the Southern Circle will amount to more than 10,000 square miles, whilst about 6,000 square miles of forest land still await settlement in the Northern Circle, so that the final settlement of all forest lands in the Presidency will be a work of many years unless the specially sanctioned forest settlement staff can be strengthened.

The cost of settlement per square mile is not given in the reports, but the Government of India have asked for an estimate to be made next year of this important item.

The survey of the forests in Madras is an important matter, and while the Government of Madras wish for a special Forest Survey, the Government of India proposes to lend some of its regular Survey officers for the work.

This survey is the more urgent, that working plans based on area are probably necessary to ensure the improvement of the forests, and the continuity of their treatment and permanency of their yield.

The average areas of forest divisions in the Southern Circle are 530 square miles, and of ranges 115 square miles, and 100 square miles in the Northern Circle.

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* Progress Report of Forest Administration in the Madras Presidency for 1886-87, by Colonel Campbell Walker, Conservator of Forests, Southern Circle, and Mr. A. W. Peet, Offg. Conservator of Forests, Northern Circle, with the orders of the Government of Madras and observations of the Government of India.

The question of strengthening the establishment is therefore urgent, as the forest area increases, but the financial aspect is not favourable to any increase in expenditure. The Madras Government is gradually acquiring a well trained executive staff, having had 19 students at the Dehra Dún Forest School in April 1887, and the excellent manner in which they are selected appears from the fact that out of 15 prizes offered last year at the school, 12 were obtained by Madras students.

Considering the weakness of the Forest Staff, strictness on the part of Magistrates in support of its authority is called for, and this does not appear to be always afforded, as Colonel Walker makes the following remarks :—

"Great difficulty is still experienced in protecting the Trichinopoly plantations (reserved forests) from the inroads of semi-wild cattle which destroy the young trees.

"The Conservator has been in frequent communication, verbal and oral, with the Collector and District Forest officer on the subject, and it is proposed to prosecute the owners and herdsmen under Section 21 (*d*) of the Forest Act after giving them due warning to adopt reasonable precautions to prevent trespass. There is still a tendency on the part of the magistracy, especially in Malabar, to deal very leniently with forest offenders. This is a fault in the right direction in the case of petty offences in ill-defined areas, but it is otherwise in the case of deliberate breaches of the law in reserved forests legally constituted and clearly demarcated by pillars and boundary lines"

The following Table exhibits the progress made in fire conservancy :—

Circle.	*Area, in square miles.*			Proportion of failures to area attempted.	*Cost*		Proportion of area under fire-protection to total area of reserves (3,577 square miles).
	Attempted.	Failures.	Actually protected.		Per square mile protected.	Per acre protected.	
				Per cent	Rs.	Pies	Per cent.
Northern, ...	1,168	152	1,016	13	12	4	30
Southern, ...	1,082	39	1,043	4	16	5	51
Total { 1886-87, ..	2,250	191	2,059	9	14	4	63
Total { 1885-86, ..	1,634	42	1,592	3	11	3	56
Increase in 1886-87,..	616	149	467	6	3	1	7

As regards grazing, the Board of Revenue of Madras and the Governor agree with Colonel Walker in the necessity for controlling all grazing on the lower slopes of the steep hills in Coimbatore, and note the fact that 15,000 head loads of grass were removed from the carefully reserved forest of Muchukota in Anantapur, which proves the great value of this forest to the neighbouring villages, situated as it is in one of the most arid parts of the Presidency. The Board also states that the ultimate object is to have all grazing in Government forests restricted, and subjected to a reasonable tax, with a view of protecting the forests and reducing the number of undersized, underbred and diseased animals now so common throughout India.

The following remarks by the Board of Revenue regarding natural and artificial reproduction give a good summary of the results attained :—

"*Natural reproduction.*—The reports as regards natural reproduction are generally favorable. In the Northern Circle the growth in the Sandúr forests is reported good, and it is so almost everywhere except in the Anantapur forests, where the Acting Conservator seems to think that the cutting of the grass may be the cause of the seedlings (*Hardwickia binata*) dying down. If so, it would be best to close certain areas altogether for a sufficient number of years to enable the seedlings to grow to a sufficient height not to need the covering. In the Southern Circle the results seem to be almost uniformly favorable, and the results of reservation are proving very encouraging. The Conservator reports that the following trees, *Anogeissus latifolia*, *Dalbergia latifolia* and *Pterocarpus marsupium* reproduce themselves plentifully by seedlings. The natural growth of the valuable timber *Pterocarpus santalinum* in Chingleput is again reported to be good.

"*Artificial reproduction.*—The areas under regular plantations in the two Circles were as follows :—

	Acres.	Cost of addition and maintenance. Rs.
Northern Circle, ...	6,423½	9,191
Southern „	11,786	29,275
Total, ..	18,209½	38,466

"The areas practically do not differ from those given in last year's report.

"The areas under cultural operations were :—

	1886-87.	1885-86.	Cost of addition made.
	Acres.	Acres.	Rs.
Northern Circle, ...	878½	751½	1,662
Southern ,, ...	2,972½	2,536	3,634

"In the Northern Circle the cyclone of the autumn of 1886 did considerable damage in Nellore, killing almost half a lakh of casuarina plants and some valuable iron wood seedlings. The mahogany plants also suffered. Palmyra seeds were planted in Cuddapah. A considerable number of blue gums were planted on the Nilgiris, and the growth was good. Over 7,000 mahogany plants were put out in Kullar reserve, and are reported to be doing well.

"The casuarina plantations in Nellore are estimated to have cost Rs. 1,70,000 up to date, and to have given an approximate return of Rs. 51,746. The return in the year was Rs. 18,455. The plantations on the Nilgiris show a surplus up to date of receipts over expenditure of Rs. 18,078.

"In the Southern Circle the management of the plantations showed greater economy to have been practised than in the previous year. In Nilambúr 123,787 teak, with 6,472 mahogany seedlings, were planted out during the year; 75,000 palmyra seeds were planted in Tinnevelly, and 23 acres were sown with *Acacia planifrons*. Insects are reported to have done much damage to the mahogany plants and the *Ficus elastica* on the West Coast. The work on the whole was successful."

The attempt to create forest areas containing mahogany standards over teak coppice is a most interesting experiment, and so are the cultural operations with sandal wood, and successful introduction of the giant Burman bamboo, *Bambusa Brandisii*.

Rs. 51,719 were spent on roads and buildings during the year, or Rs. 26,592 less than the revised budget grant, the Divisional Forest officers having too much other work to do to complete all the works estimated for; in fact it is evident that the settlement and demarcation of the forest area is at present the most urgent work in hand.

As we remarked last month in our notes on Forestry in Bombay, it is impossible to arrive at any clear idea of the yield of the forests, unless the statements are given in similar units for different Circles, and cubic feet for timber and fuel, and rupees for minor produce and grazing are the units generally adopted throughout India.

The financial results of the year are compared with those of the previous year in the subjoined statement :—

Circle.	Receipts.	Charges.	Surplus or Deficit.	Proportion of Surplus to Receipts.
	Rs.	Rs.	Rs.	Per cent.
Northern, ...	5,52,248	4,34,966	+1,17,282	21
Southern, ...	6,94,535	7,20,721	− 26,186	..
Total in 1886-87, ..	12,46,783	11,55,687	+ 91,096	7
„ 1885-86, ..	11,98,650	9,37,972	+2,60,678	22
Increase or decrease in 1886-87,	+ 48,133	+2,17,715	−1,69,582	− 15

The revenue of the year was obtained as follows :—

	Timber.	Fuel.	Bamboos.	Sandal.	Minor produce.	Grazing.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Departmental works, ..	1,11,800	1,10,200	3,500	14,100	36,400	..	2,76,000
Export by purchasers, ..	2,09,300	2,78,000	1,09,000	..	2,71,800	81,200	9,49,300
Other revenue, ..	..	..	..	..	..	..	21,600
Total, ..	3,21,100	3,88,200	1,12,500	14,100	3,08,200	81,200	12,46,900

whilst the expenditure may be thus distributed—

	Rs.
Settlement of forest reserves, ..	54,600
Leases of forests, ...	89,600
Improvement of forests, (planting, sowing, fire-protection, &c.), ...	1,21,600
Buildings and roads, ...	51,700
Departmental conversion and export of produce, ...	1,73,700
Export by purchasers, ...	76,000
Elephants, cattle, stores and plant, ..	23,300
Carried over, ..	5,90,500

		Rs.
Brought forward,	..	5,90,500
Establishments, ...	..	5,55,000
Other items, ...	..	10,200
Total,	..	11,55,700

No figures are given in the report to show the value of the produce given away to cultivators, but the Collector of Vizagapatam has been called on by Government to explain his action in giving away free grants too profusely.

The proportion of expenditure as compared with income is very high, but there is a gradual increase in the revenue from grazing and sale of minor produce, and with the steady development of the revenue, Madras forests will in future years doubtless prove financially successful.

AGRICULTURE IN RUSSIA.*

THE paper under notice forms one of a long series of Annual Reports written by Diplomatic and Consular Agents of Her Majesty in all parts of the world, a list of which comes next to the title page.

The amount of labour involved in the preparation of the paper on Russian Agriculture appears from the fact that 2,217 correspondents furnished the necessary information to Mr. Wagstaff.

The weather during 1887 was favorable to agriculture, the rye and winter wheat crops being greatly above the average, whilst the spring wheat gave an average crop suffering in three provinces from drought. Oats and barley and millet were above the average, and buckwheat below it, potatoes good, linseed, hemp and rape-seed good.

Mr. Wagstaff gives a comparative table of the harvest of Russia during the last four years, but as the results are in thousand *tchetverts*, which we are afraid will be an unfamiliar term to most of our readers, we forbear to give the figures, and will merely give the percentages of the different crops in 1887, *viz.*, rye 42, oats 32, wheat 13, barley 8, buckwheat 3, millets 2.

The hay crop has been very good, except in the Southern steppe provinces and those along the Vistula.

* *Diplomatic and Consular Reports on Trade and Finance.*

Report for the year 1887 on the Agriculture of Russia, by Consul W. G. Wagstaff. Published by Her Majesty's Printers, and presented to both Houses of Parliament. March 1888. Price, one penny.

The fruit crop was good, except that in the Crimea grapes were small and melons and water-melons yielded badly owing to drought and frost.

Before proceeding, we may remark, that with so many International Committees to determine geological technical terms, standard time, gauges of screws, &c., &c., it is a pity that we cannot agree on some international standard of measures, and the metrical system being the best generally known, Mr. Wagstaff might have given his results in hectares, or in English acres, as he is writing for English readers.

Mr. Wagstaff devotes several pages to a discussion of the cost of the production of wheat in Russia and abroad, and here it is no easier to follow him, for quantities are given in poods (36 lbs.), and values in roubles and cents, the silver rouble being worth about Rs. 1-8, whilst the value of the paper rouble is said to be only 11*d.*

Prices have fallen considerably as compared with the years 1879-82, and in spite of the favorable harvests of the past two years, there has been a great dearth of money in Russia, and the positions of land-owners, whose estates are burdened with heavy debts, is said to be most precarious.

Some of the Western European Countries have put heavy import duties on Russian imports, and thus increased the agricultural difficulty, whilst we are told that, the business is not intelligently managed, qualities of produce being raised which have lost their former market value.

The very critical position of agriculture will perhaps remedy these defects, as farmers must keep pace with science, and study markets, extending one branch of agriculture, or restricting another, according to circumstances.

Although prices have fallen 20 per cent. since 1881, they still cover the cost of production, and on most estates in wheat regions give a decent profit.

The only country where the cost of production is less than in Russia is Hindustan, being much higher in North America, and in most parts of Western Europe, so much higher, that Russian wheat is only kept out of their markets by heavy duties.

The average yield of an acre under wheat in Russia is said to be 25 poods, or 900 lbs., about 8 quarters.

The average cost of production of one pood (36 lbs.) of wheat is said to be about 55 cents (hundredth of a rouble), and the average sale price (1884-86) 75 cents, so that the profit is about 20 cents. Mr. Wagstaff compares the cost of production of 36 lbs. of wheat in different countries as follows :—

	In paper currency.	In gold currency, allowing for rate of exchange.
Russia, ...	55 c.	55 c.
North America, ...	55 c.	42 c.
Germany, Hungary, Roumania and Italy, ...	12·15 c.	65 c.
France, ...	12·45 c.	81 c.
England, ...	12·70 c.	95 c.

As the Russian farmers purchase very few articles from abroad, the cost of production in Russia is independent of the rate of exchange, whilst the prices are greatly affected by this, and the proceeds are higher the lower is the value of the rouble, and *vice versâ*.

Mr. Wagstaff considers that wheat can still be delivered at a profit to the Western European markets, whilst the distances from Russian ports to London and Marseilles are much less than those from Hindustan and North America, so that if trans-oceanic wheat ousts Russian wheat in its present markets, this will be due to the influence of other factors rather than to the conditions of production.

We conclude by giving *in extenso* Mr. Wagstaff's remarks on the question—*Shall we abandon Wheat Culture?*

"The question whether the cultivation of grain is to be continued in Russia, or not, has been under the notice of periodical journals and newspapers, and of different societies, for some time past. At the end of each agricultural season, the same question arises in Russia as abroad:—'Shall we find buyers for our produce, and will the prices repay the cost of production?' This question constantly recurring causes much reflection to both theoretical and practical agriculturists.

"At the present time, many opinions are expressed respecting the future of our wheat production. Some persons, on considering the increasing export of grain from non-European regions to the Western markets, and the fall in prices of grain, come to the conclusion that our agricultural industry is a thing of the past, and that, under no circumstances, can it regain and maintain its position.

"Those who share this dark view only offer one way of evading the calamity. The cause of the depression is said to be that our agriculturists for past centuries have restricted their production to three or four kinds of grain. The confinement of agricultural activity to one special class of culture prevents us from conforming to the changes in the requirements of markets and the conditions of supply. Up to the present time our attempts to conform with these demands have been limited to lowering the prices of produce and replacing the culture of one kind of

grain for another. Thus, at one time, wheat was cultivated to the detriment of all other sorts of grain, and afterwards other cereals took the upper hand. The result of all this only hastened the heavy crisis through which agriculture is now passing. It is, therefore, necessary to abandon the present system of cultivation and adopt other special branches of agriculture. Then our rural economy is safe from all danger.

"The favourable conditions for establishing such branches are not for us to discuss.

"With reference to cattle-breeding and dairy produce we are placed under special favourable conditions, possessing as we do a large variety of pasture lands, beginning with immense plains and ending with enormous tracts of elevated pasture lands. Respecting the cultivation of special agricultural produce, the conditions are not less favourable. For instance, the culture of fruit could be carried on successfully in three-fourths of Russia. Silk, vines and tobacco, could also be cultivated throughout the Southern Provinces. The extreme South also offers facilities for raising cotton, medicinal and aromatic herbs, cork-wood and the tea plant. In conclusion, the cultivation of oil and other industrial plants could be carried on in most parts of Russia. Besides, there is also no dearth of markets; even if we cannot count upon those abroad which are supplied by experienced hands, we have our own immense markets in the interior, which at present are supplied by foreign producers of these articles. Taking only the necessaries of life, which could be successfully cultivated in Russia, our markets received in 1885 85,000,000 roubles worth of goods and 129,000,000 in 1884. In the year 1884 we imported from abroad, cotton, timber, cork-wood, living and dried plants, untanned skins and hides, tallow, butter, spirits, raw silk, wool and plants for dyeing purposes, to the value of more than 100,000,000 roubles. If our agriculturists would undertake the production of all these articles and keep these millions of roubles in the country, they would be amply repaid for losing the foreign grain markets.

"These are the remarks of persons who despair of the future of our grain trade, and advise us to abandon it and pay more attention to raising butchers' meat and cultivating special agricultural products.

"There are other persons, however, who take a totally different view of the case. They state that the depression is only temporary, and they hope soon to see a thorough revival. The principal faults of our wheat culture, they say, is our complete disorganisation and the low ebb of our economic and financial condition. It is only necessary to procure good seed and agricultural implements, abandon the present ruinous manner of cultivating the land, lessen the charges and adopt the intensive system of cultivation, reduce the outlay and enter into direct communication with foreign markets—and our grain will then, in their opinion, regain

its position and successfully compete with all who supply the European grain markets. If we could only, at the same time somewhat improve our financial position and relieve our producers from foreign markets, our grain trade would at once regain its lost position, and Russia would again become the granary of Europe.

"Such are the defects of our rural economy and the means of curing it, as set forth by many theoretical and practical agriculturists.

"The evils from which our agriculture is suffering are clearly apparent, and the symptoms can be correctly defined, but, as regards the proposed measures of treatment, it is doubtful whether they possess the curative power ascribed to them. To abandon cultivated land and convert it into pasturage for cattle is not difficult, but such a measure is only practicable where the population is fully guaranteed with sufficient land indispensable for raising grain, or in districts where the majority of the inhabitants are completely relieved from following farming, and have other means of providing their bread. How is it possible for us who are daily calling attention to the insufficient allotments owned by the peasants, and spending tens of millions of roubles in increasing them, all at once to refuse to comply with the urgent needs of our grain culture, and convert millions of dessiateens of cultivated tracts into pasture and grass lands? Besides, is such an object attainable? At any rate, notwithstanding the low profits on grain cultivation, they are much higher than in raising cattle for butchers' meat, even if the latter industry had been in existence many years past and was securely established. Upon these conditions, and with the need of land, the peasant being engaged exclusively in the raising of cereals, will always be able to offer more for cultivated land than would be obtainable were it converted into pasturage. The introduction of special branches into rural economy is highly commendable, but all large agriculturists are only able to adopt them, more or less, as auxiliaries. At those places where they exist independently, they are upon diminutive proportions, or as industrial enterprises based on a commercial footing. If such is the case, it is hardly possible to improve our agriculture by converting millions of dessiateens of cultivated land into vegetable and fruit gardens, or melon, cucumber and tobacco plantations."

FOREST CONSERVANCY IN THE JEYPORE STATE, RAJPUTANA.

We have before us the Jeypore State Report for 1886, and regret that want of time has prevented us from reviewing it sooner.

The report is written by Bhai Sadhu Singh, a student of the Forest School, and who has been appointed for three years as Forest

officer of the Jeypore State. It is a very creditable production, and is reviewed by Colonel Jacob, Executive Engineer, Jeypore State, under whose general supervision forest conservancy has been fostered and finally organized. There is also a memorandum by Dr. J. P. Stratton, late Resident of Jeypore, and a note by the Inspector General of Forests with regard to Mr. McA. Moir's proposal on the formation of State forests in Jeypore, that officer having been deputed by the Government, N.-W. Provinces, from November 1885 to March 1886, with the object of drawing up a detailed scheme of forest conservancy. It may be mentioned by way of introduction, that in the Jeypore State a considerable area of waste land has been subject for years to a rough kind of forest conservancy, with the object of preserving the game. These lands were therefore placed under a State Department, called the Shikarkana, which was charged with the duty of encouraging and protecting the game, and of course preventing the actual felling of the jungles, but no very strict rules with regard to the grazing of cattle seem to have been observed. All these areas have, therefore, been included in the proposed reserve, and a great deal of jealousy between the subordinates to the Shikarkana and the newly formed Forest Department was of course to be expected, but by the exercise of considerable tact on the part of Colonel Jacob and Sadhu Singh, it is satisfactory to find that less friction took place between the two departments than was anticipated.

During the year under review fair progress was made in temporarily demarcating and enquiring into the many complicated and conflicting privileges or imaginary rights of those interested in the proposed reserves, so that the area actually demarcated as first class reserves was only 2,294 acres, *viz.*, the Amanisha and Moti Doongri reserves.

Ten miles of fencing were constructed along the boundaries of these two reserves, which operation is a most necessary work in a country overrun by cattle like the Jeypore State.

Twenty-one miles of other proposed reserves were surveyed during the year, at a cost of Rs. 179, which charge seems to be reasonable.

A set of simple Forest rules were finally sanctioned by the Darbar, together with instructions as to the procedure to be followed by the Forest officer in dealing with forest offences. The rules are said to have worked well, and great caution was observed by the Forest officer in enforcing them gradually at first.

Under artificial reproduction a good commencement was made, and some interesting works were executed, having for object the

checking of the rolling sand dunes so common in the Jeypore State.

This consisted in planting lines of "Pani," or *Saccharum Sara* grass at right-angles to the prevailing winds. The total length planted at the Amanisha and Moti Doongri reserves was 111 miles, at a cost of one anna per 100 running feet.

A number of sissu, mango, nim and other trees were planted out, but as all trees planted in the Jeypore State have to be watered by bhisties for three or four years, these planting operations were naturally limited. Extensive sowings of all kinds of hard jungle trees were effected, the total amount of seed sown having been 35 maunds, and considering that there were only 25 rainy days, and 17 inches of rainfall, the result was fairly successful.

In conducting these operations, the Jeypore Forest officer has endeavoured to profit by the experience gained by Col. Jacob, who for many years past has tried many interesting experiments with the main object of fixing the rolling sands already mentioned in the neighbourhood of the city. Fellings on the coppice system have been arranged for in selected places at several of the reserves, but these were not actually commenced during the year under report, though the coppicing of 100 acres was sanctioned by the Durbar.

Judging from the experience gained at Ajmere, these operations ought to turn out successful and profitable.

The Forest officer's report concludes with an appendix on cultural operations, and contains some interesting information regarding date cultivation, obtained from Dr. Bonavia, who appears to be a great authority on this subject, and which is of great interest for the Jeypore State. These suggestions were at once put into force, and a large number of seedlings were raised both in the Raj gardens and by private persons, to whom seeds were distributed.

Next follows a valuable memorandum by Dr. Stratton, late Resident of the Jeypore State, on the proposed forest management, and his suggestions should be carefully attended to by the officer in charge of the forest operations.

Dr. Stratton concludes his memorandum with some interesting and valuable hints on the sand-binding plants of the Jeypore State, as well on bushes valuable for hedges and other useful purposes.

Last of all comes a memorandum by the Inspector General of Forests on Mr. Moir's proposals for the formation and management of State reserves in Jeypore. He expresses his opinion that the introduction of proper forest conservancy arrangements in the Jeypore State is much wanted, and that there is every reason to believe that they will turn out as successful as at Ajmere if the efforts of the Forest officer are properly supported by the Durbar.

The Inspector General criticises the proposed division of the State reserves into 1st, 2nd and 3rd class forests as too complicated, and states that this arrangement has been abolished in the Central Provinces. This classification has, we understand, been mainly prompted by the peculiar circumstances of the land tenure and other important conditions of the forest question in the Jeypore State.

The proposed classification has, therefore, been defined with regard to the relative damage done by the different kinds of grazing or browsing animals, the grazing question being of primary importance in dry Rajputana as far as forest conservancy is concerned—

1st class reserves are those in which all grazing is prohibited.

2nd class reserves are those in which cows and bullocks are to be admitted for a certain number of months in the year.

3rd class reserves are those in which there is no restriction to grazing, but where firing and wood cutting are prohibited.

The main reason for allowing grazing in the 2nd class reserves is that there are often many villages in their vicinity, and the total exclusion of all cattle would be most difficult to carry out and embarrassing to the population.

As regards the 3rd class reserves they are burdened with many complicated rights, and the Durbar seems to have a feeble hold on them, so that under the circumstances it was deemed advisable not to attempt more than the protection of the trees and shrubs at least for the present.

It might therefore be difficult to attempt at once to apply the 1st class forest restrictions to the 2nd and 3rd class reserves, and if this were done, all the same unpleasant complications which took place in the Odeypore State, Rajputana, might arise in Jeypore also, and lead to the abandonment of forest conservancy.

Under these circumstances, therefore, it may perhaps be found better to adopt a middle course, and to introduce forest conservancy in a gradual and cautious manner, and not attempt too sweeping measures at first.

The Inspector General at the end of his remarks states, that he does not consider the total area it is proposed to place under forest conservancy sufficient, and in this we concur, it being only 1·6 per cent. of the whole State, or 214 square miles.

Timber Market.

We are able to report a very satisfactory market for the past month, with steadily improving prices and an active although somewhat speculative demand. The actual rate of consumption is still disappointing, and this is the one unfavourable element in the situation; but it will be observed that stocks are unusually low, and it is almost invariably the case that the consumption rises and falls in a greater or less degree, according to whether the quantities to be disposed of are large or small; and again the present comparatively high prices tend rather to the using up of old stocks at private yards than to fresh draughts upon goods piled in the public docks. It seems very evident that during the present autumn London must either continue to pay dearly for supplies, or put up with a very light importation, for country and continental markets are ready to take whatever the shippers still have for disposal, and also to pay the present enhanced rates of freight.

East Indian Teak.—The deliveries for the first eight months of the year have been 11,395 loads against 7,190 loads in 1887, and for August alone 1,731 loads against 500 loads. With the improvement in the shipbuilding trade the consumption of this wood continues to increase, and there is nothing so far in the prices to check the demand for general purposes. Floating cargoes are freely inquired for, and there is every probability of the continuance of a good demand for the cargoes at present under charter.

Satinwood.—*East India*—has been in better demand, but it is only at low prices that sales can be effected.

Ebony.—*Ceylon.*—The demand continues dull, and although some sales have been made, prices show no improvement. *Mauritius.*—Sizeable, good wood is asked for, but there is sufficient stock of small wood.

Boxwood.—*Persian.*—Stocks are moderate, and there is some enquiry for sizeable, good wood.—*African.*—Small parcels of good pieces would sell well.

. Churchill and Sim's Wood Circular. London, 5th September, 1888.

IV. Notes, Queries and Extracts.

Forest Conservancy in Ceylon.*—The necessity for the conservation of the forests of Ceylon was first brought into prominent notice in 1873 by Doctor (now Sir Joseph) Hooker, who, on the report of Doctor Thwaites, then Director of the Botanic Gardens, Peradeniya, addressed the Secretary of State for the Colonies on the subject of the destruction of the forests in Ceylon, and the evil effects resulting therefrom upon climate and upon the natural resources of the Colony in future generations.

The Government of Ceylon had been alive to these evils, and to a certain extent had endeavoured to provide against them, but as forest conservation on a sufficient scale demands a considerable expenditure at the outset until the revenue derived renders a Forest Department self-supporting, it did not feel itself in a position to grant the necessary supplies for the purpose. Notwithstanding this, efforts were made by the Government in other directions to mitigate the evils attending indiscriminate sales of land. In 1882, Mr. Vincent, of the Indian Forest Service, was, on the application of the Ceylon Government, deputed by the Government of India to report on the forests of Ceylon. His valuable report was published as a Sessional Paper, No. 43 of 1882.

As the result of this report, and of a desire on the part of the Government to carry out forest conservation on a satisfactory basis, an Ordinance was passed in the session of 1885, intitled "The Forest Ordinance." The object of this Ordinance and of the rules made under it is, in the first place, to select suitable areas of forest lands and to constitute them State reserved forests; to buy off or to commute by the grant of land any rights which the population in the vicinity may have acquired in these lands; to mark off on the ground the boundaries in an unmistakeable manner: to place these areas under effective protection; to improve them by sowing and planting wherever necessary; and, generally, to introduce system where there had been no system. As the result of systematic treatment, it is hoped to guarantee a permanent sustained yield of timber, fuel, and minor forest produce, not only for the existing, but for future generations, to improve the climatic conditions, and

* Report of the Conservator of Forests for 1887.

by judicious restrictions in regard to harmful cultivation to meet the wants, and safeguard the interests of all classes of the community. There can be little doubt of the success of these measures, provided they are carried out with intelligence, fairness, and firmness on the part of the Government officers, together with an appreciation on the part of the people of the general benefit to the community that the Government has in view.

Although the object of the State in the execution of the important trust committed to it, both in regard to the welfare of the present and future generations, is strictly conservative, and has higher aims than the mere acquisition of revenue; still, judging from the results of forest conservation in India, the revenue to be derived from proper management is far in excess of the cost of establishments and working. Ceylon has in its forests timber and minor produce of not less value, comparatively, than those of India, where the receipts in the year 1883-4 amounted to £1,052,190, and the clear profit to £403,815. Up to a very recent period this valuable State property in Ceylon, more particularly the forest produce, has not been disposed of to the best advantage. The Crown forests have been systematically plundered by a gang of native timber thieves, who, often with the connivance of native headmen, gained a rich harvest, thereby depriving the people generally of a revenue which should have passed into the Colonial Exchequer, and should have thereby benefitted the community at large. An organised Forest Department will in the future aid the Government Agents in securing to the country this important branch of the revenue.

Not only are our forests worth preserving for the valuable timber, fuel, and minor produce they contain, and for the employment that forest management provides for a certain proportion of the population; but by judicious conservation, their indirect value as affecting the climatic conditions, and therefore the wants and interests of the people generally, will be greatly enhanced. There can be little doubt that forests render climate more equable, increase the relative humidity of the air, and possibly augment the rainfall. In tropical countries like Ceylon, where the rain falls at certain seasons only, and then falls in heavy showers, a covering of forest protects the soil from being washed away, and thereby mitigates the silting up of rivers and low lands. In this respect Ceylon has in the past suffered much by denudation. Again, forests regulate the water-supply, insure the sustained yield of springs, and render the flow of water in rivers more continuous; they reduce the velocity of the wind, and afford protection to the neighbouring fields.

Further, forests afford shelter to cattle and useful birds, and under suitable treatment improve the healthiness and picturesqueness of the country.

Many instances might be cited of the evil effects of forest denudation in almost every country of the world ; but some very striking ones were given in evidence in 1885 before the Select Committee of the House of Commons on Forestry, affording a useful warning of what might happen at no distant date in Ceylon, unless preventive measures are taken. It was given in evidence by the late Political Agent of Jinjira, in Western India, that that Native State, about 40 miles long and from 15 to 100 miles wide, was at one time entirely covered with forest, but owing to the demands of the city of Bombay, three-fourths of the forest, in consequence of indiscriminate felling, disappeared within seven years, and the remaining fourth was only saved with difficulty. The result to this Native State was simply ruinous, and if unchecked, would have deprived it of all its resources. Another instance was brought before the notice of the Committee. The district of Ratnagiri, 50 years ago, used to be the great rice-producing district of the west of India, when there were dense forests extending up to the Western Ghâts. In the present day, the country up to the crests of the hills has been laid bare of forest growth, and the people complain bitterly of the bad yield of the rice land below, which has been attributed to the destruction of the forest operating to prevent the water from being stored upon the hill-sides : it runs away in violent floods instead of flowing gently over the country. There are parts of Ceylon at this moment, in the Southern and North-Western Provinces and in the Province of Uva, where the havoc of the chena cultivator threatens to repeat the disasters of Ratnagiri.

In the middle of 1887, Mr. A. Thompson, of the Indian Forest Department, was deputed from India to advise the Government of Ceylon on the conservation of its forest. That officer, however, speedily lost his health, and in September of the same year resigned his appointment. Before leaving the Island he expressed the opinion that the most pressing matters to be undertaken were the selection, demarcation, survey, and settlement of reserved forests. Mr. Thompson, owing, it is presumed, to want of time, left behind him no scheme of operations for the coming year. On his departure in October the Surveyor-General was appointed Acting Conservator of Forests in addition to his own duties. One of the most important matters that the Acting Conservator had to submit for the instruction of Government was the position of Foresters

in relation to the Government Agents and the newly-created appointment of Conservator of Forests. There is much to be said from a technical and departmental point of view in favour of Foresters being entirely under the control of the Conservator of Forests; and, on the other hand, there is a good deal that may be adduced from a political point of view in favour of placing the Foresters under the Government Agent. From a technical point of view it is of the first necessity that the working of the forests and the cultural operations connected therewith in order to ensure the proper continuity of the work, should be considered solely the business of the Conservator of Forests, subject of course to the supervision of Government. This reason alone might by many be considered sufficient cause for the Forest officers to be placed beyond possibility of interference by Government Agents. On the other hand, from a political point of view, it might be very properly urged that a Forest Department, working entirely without the knowledge of the Government Agent, might be neglectful of the interest and requirements of the people, and be prone to press the provisions of the Forest Law too hardly against them.

With these chief considerations in view, I submitted to Government that a middle course was advisable, and that the Forester of a province should carry out the various forest works of demarcation, conservation, cultural treatment, &c. (as agreed upon annually by the Government Agent and the Conservator of Forests, and approved by Government) under the authority and protection of the Government Agent, while in administrative matters connected with discipline, pay, promotion, transfer, &c., he should be directly under the Conservator of Forests. By this dual subordination, provided the Government Agent and Conservator of Forests worked harmoniously together, and co-operated towards the common end both have in view, I conceived that the interests of both forest conservation and of the people would be met, in that the just demand, and requirements of forest conservancy will be attended to under the full authority of the head of the province, while full control over the Departmental finance and over the organisation and technical part of the work, is reserved to the Conservator of Forests, Government was pleased to approve of this recommendation.

The matter next in importance was to draw up a project of operations for 1888. The Acting Conservator of Forests placed himself in communication with the Government Agents, and after learning their views drew up the following plan of operations for the year 1888 under the respective headings of—(*a*), Forest Demarcation; (*b*), Timber and Firewood Supply; (*c*), Re-afforestation;

(*d*), Extra Establishment. The plan of operations was sanctioned by Government in March 1888.

(*a*). *Demarcation.*—This subject is considered to be of primary importance, because, until the forests are selected for reservation, and the rights of the neighbouring population judicially inquired into and settled, and the forest boundaries properly defined and marked out on the ground, the law for their protection against encroachment and illicit felling cannot be satisfactorily enforced. It was therefore recommended to Government that the surveys required as preliminary to the examination of claims, and for the demarcation of boundaries on the ground should be actively proceeded with so far as the resources of the Survey Department would allow. It was further represented that the first measures of forest conservation should be directed to the neighbourhood of the large cities and towns, where, owing to the requirements of a dense population, the forest is rapidly disappearing for want of effective protection. At the same time, the firewood supply for the railway, both as it exists at the present and its probable requirements in the future must not be lost sight of. It was submitted to Government that, speaking generally, there is no immediate necessity to demarcate the forests in the vast tracts which cover the whole face of the Northern, Eastern, and North-Central Provinces, as these are less open to encroachment, but that all available strength should be concentrated for the present on the remaining provinces. In the event of this suggestion meeting with the approval of Government it was proposed, in the Western Province, to demarcate the Mitirigala and Kananpella forests, both of them important from their situation near to Colombo, on the banks of the Kelani. The survey of the Kelani reserve, which was commenced in 1887, will, it is hoped, be completed in 1888. Nearly the whole of that part of the so-called reserve which lies in the Central Province is found to be almost non-existent; while that part which lies in the Western Province will only be of value as a climate reserve. The rest has disappeared before the squatter and chena cultivator.

With regard to the large surveys carried out under the Adam's Peak range in the villages of Gilimale and Bambarabotuwa, the plans of which are now ready, it will be for Government to determine what parts of the forest should be reserved for climatic and timber purposes, and what should be sold. When this is done, the reserved forest should at once be demarcated, and the rights of the native determined and judicially settled.

In the North-Western Province it is proposed to demarcate important reserves just outside the towns of Puttalam, Kurunegala,

and Chilaw, as a first step. There are other important forests in this Province which must be demarcated at an early date, before they become a prey to the chena cultivator.

In the Central Province there is work to be done in the selection and demarcation of forests in the Matale District, while in the Nuwara Eliya District the importance of maintaining the boundaries of Crown forests against encroachment becomes more and more marked.

In the Northern Province it is desirable to select and demarcate several thousand acres as a reserved forest within accessible distance of the town of Jaffna.

(*b*). *Timber and Firewood Supply.*—By consensus of opinion among the Government Agents, the present system of allowing timber to be cut in Crown forests by contractors for the use of the Public Works Department or by private individuals on permit is universally condemned, as little or no check can be exercised, and the revenue fails to get the value of the timber carried away. It is proposed to introduce an entire change in the system, or want of system, and in lieu of it to establish depôts at the chief centres where there is a sufficient local demand for timber and firewood to warrant the expense of their establishment. The trees in demand for timber will then be felled as they arrive at maturity, allowed to season, and be transported to the depôt to be sawn to the best advantage. In cutting out these trees there will be much branch wood which has hitherto been left to decay in the forest, but which will now be brought to depôt for sale as firewood. By thus utilising every part of the tree, whether cut down for timber, or in thinning out, or in opening out the necessary cart tracks, there is little doubt that considerable revenue will be derived. Moreover, the firewood supply being undertaken by the Forest Department, traders and their coolies will be kept out of the Crown forests, which they have been accustomed to rob with impunity. It may be well here to mention that there seems a tendency in some places to fell timber before it arrives at maturity. In this green state timber lacks strength and durability, is more susceptible to dampness and to the attack of white ants, and is especially liable to split while seasoning. Where firewood is sold by weight there is an especial tendency to fell in the green state, for then the firewood is much heavier than when mature. There is a certain age at which a tree reaches its maximum weight: after that it loses in weight but gains in strength and durability until the age of maturity is reached.

Further, it is proposed, that instead of, as heretofore, the Gov-

ernment Agents felling separately, each for his own Province and without reference to the others, the annual felling should be regulated by the Conservator of Forests in communication with Government Agents according to the demands for Government use, the local demands of the public, and for export. In this way the balance between demand and supply will be better maintained.

It is proposed to have two main depôts, one at Colombo and one on the east coast. To the former depôt would be consigned all ebony, the best satinwood, and the better classes of cabinet woods, such as find favour for use in the capital or for export to Bombay, China, or England; while at the latter depôt would be sold such woods of the better classes as are in demand at Madras, but whose prices would not bear the cost of freight to Colombo. All inferior logs of cabinet woods and other timber of inferior sorts should be sold locally.

The principal of this arrangement may be summarised, that all superior classes of timber should be sold at Colombo when competition is rifest, while the inferior classes that would not pay the cost of transport should be disposed of locally.

During the year 1888 it is proposed to establish depôts at the following places:—

Western Province,	...	Colombo. Kalutara (later on).
North-Western Province,		Kurunegala. Puttalam.
Northern Province,	...	Jaffna.
North-Central Province,		Trincomalee (Eastern Province).
Eastern Province,	...	Batticaloa.
Southern Province,	...	Galle.
Central Province,	...	Nuwara Eliya, Nanuoya, Kandy, Matale.
Province of Uva,	...	Badulla, Haputale.

The question of supplying sleepers to the railway will have serious attention. The woods of Ceylon have not had a fair trial up to the present time, and it is very important that we should, if possible, meet the demand for sleepers from our local resources. Palai (*Mimusops indica*) and Kumbuk (*Terminalia glabra*), which are most abundant in this Island, would, it is believed, be excellent woods for sleepers, and there are several others deserving of trial.

(*c*). *Re-Afforestation and Conservation.*—It is the opinion of experts that questions of re-afforestation may speaking generally, wait in this country until the more necessary measures of demar-

cation have made progress. In regard to re-afforestation there seems to be some misapprehension. It appears to be supposed that any kind of tree, whether indigenous or exotic, only requires to be put into the ground in order to grow. No greater mistake could be made, and disappointment and waste of money can only result from any such treatment. Some seedlings require sun, others shade; while soil, aspect, climate and altitude have all to be taken into account in determining what species will thrive in a given place. Projects of re-afforestation must be very carefully considered, and nothing done with precipitation. One great defect hitherto is, that some of the plantations in this country are neglected after they are once started, and for want of the requisite thinnings the young trees have grown up weakly, and are of little value in consequence. This is, of course, due to the want of the necessary establishment to look after the trees until they have become well started; but it is none the less an unfortunate circumstance. As a rule, it is desirable to take up large areas rather than small for re-afforestation—say, not less than 500 acres—to fence it in properly in proportion as it is planted, and not to spare labour until the young trees are well established. Small areas incapable of extension are costly in supervision. Indigenous timbers should be cultivated in preference to exotic, except in special localities. The mainstay of our work for some years should be the planting of the species which are known to thrive and produce good serviceable timber in the localities where they are to be planted. Many of our forests have been overworked, and require rest; for instance, in parts of the Eastern Province, it will be the duty of the Forester to make a careful survey of such forests, so as to determine the period of rest, to examine what prospects there are of seedlings of the better species growing up, or, if not, what areas should be replanted, and with what species. I do not quite share the view held by Mr. Vincent that reproduction is generally bad in this country. On the contrary, I have been much surprised at the way in which satin and halmilla, two of our most important trees reproduce themselves vigorously in unexpected places, such as on the borders of chena lands or in places where the leaf canopy has been destroyed, and light accidentally let into the forest: given, of course, that the conditions in other respects are favourable to the growth of these species. In some of the ebony forests, too, the reproduction is satisfactory. All that is required is the establishment necessary to assist the saplings, and by fellings to preserve them from being choked by inferior species. With respect to the conservation and working

of the forests, we shall, until the surveys and demarcation are complete, have to limit our cultural operations of the system known as that of *natural regeneration*, whereby the trees are only gradually removed as they arrive at maturity, so as to effect the regeneration of the forest by seed in the natural way, and to afford protection for a time to the young growth. With this cultural treatment we must combine the mode of working by compartments, whereby all the different compartments included in a forest are worked annually in rotation and given complete rest during the remainder of the period, so as to admit of their being properly protected during the years of reproduction. By this arrangement timber-cutters and coolies will be prevented from indiscriminate felling over the whole forest, which has done so much harm in the past.

(*d*). *Extra Establishments.*—As it is most important to check the illicit felling, which goes on unimpeded more or less over the whole Island, it is proposed to augment the present establishment by adding to it river watchers, forest rangers, and forest guards, in order to help in the detection of these malpractices, and to bring them to official notice.

COLOMBO,
April 14th, 1888.

F. C. H. CLARKE,
Actg. Conservator of Forests.

THE timber trade in Siam is rapidly increasing, and several large rafts of teak, which are said to exceed in size the one that lately broke loose off the coast of Canada, are shortly expected in the Bangkok river. Their arrival will probably block the river for some three or four miles.—*Timber Trades Journal.*

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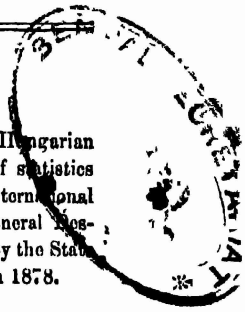

FORESTRY IN HUNGARY.*

By Lt.-Colonel F. Bailey, R.E.

Note.—The greater part of the information regarding the Hungarian forests, given in Chapter I., was derived from the volumes of statistics prepared by the Hungarian Forest Department for the International Exhibition at Buda-Pesth in 1885. That given in the "General Description" of the Bánát was obtained from the work prepared by the State Railway Company for the International Exhibition at Paris in 1878.

CHAPTER I.

THE HUNGARIAN FORESTS.

Area, Elevation, Climate, Species, and Distribution of Trees.

The total area of the kingdom of Hungary, including Croatia and Slavonia, is 125,370 square miles, of which 35,459 square miles, or over 28 per cent., are forests, owned by the following classes of proprietors :—

	Square Miles.		
The State, ...	5,553	or 16	per cent.
„ studs, railways, War Department,	170		
Departments and Communes, ...	8,200	or 23	„
Corporations and Ecclesiastical endowments,	2,071	or 6	„
Public foundations, ...	319	or 1	„
Private „	8		
Trustees, ...	1,999	or 6	„
Joint proprietors, ...	5,101	or 14	„
Joint Stock Companies, ...	654	or 2	„
(A.)	24,075	or 68	„
Private persons (B.)	11,384	or 32	„
Total, ...	35,459	or 100	„

This gives nearly 1½ acres of forest per head of the population.

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Forests in Class (A.) must, under section 17 of the Forest Law, be managed in accordance with the provisions of a working plan, approved by the Minister of Agriculture, and framed on the principle that they are required to give a constant annual yield for ever. Consequently no portion of them can be disforested. But the private forests, about one-half of which are owned by a small number of proprietors, some of whose immense domains cover many square miles, are, unless they have been declared "Forests of Protection" under the law, worked according to the wish of the owner; who, however, may not disforest any portion of them which grows on a purely forest soil—that is to say, a soil which is incapable of being profitably cultivated, either as fields, gardens, or vineyards, or of being used as meadow land.

Section 2 of the law includes, under the head of Forests of Protection, all forests situated in high mountain regions, on loose stony soil, alpine plateaux, peaks, ridges, or steep slopes; also those which serve either as a shelter against dangerous storms, or as a protection against landslips, inundations, and avalanches, and the removal of which would consequently involve injury to lands and lines of communication situated below them. The law provides that, within five years of its promulgation, a list of all such forests must be prepared; that they must all be demarcated; and that, no matter to whom they belong, they must be worked in accordance with the provisions either of a working plan, or of rules approved by the Minister of Agriculture.

The area of the State forests was much larger in former years than it is now—a loss of 20 per cent. having been experienced since 1878. This is mainly due to the commutation of rights, many of which have been got rid of by the surrender of land given in exchange for them; but there is still a good deal to do in this direction, though not nearly so much as has already been accomplished between 1880 and 1884. The diminution from this cause of the area of the State forests amounted to 1,427 square miles. The following areas are administered by the Forest Department, in addition to the State forests (5,553 square miles) shown above, *viz.*:

		Square Miles.
In towns, ...		4
Unavoidably retained as being enclosed within forest boundaries, ...	Arable fields, ...	48
	Meadows, ...	63
	Pastures, ...	120
Alpine pastures, ...		325
Unproductive land, ...		153
	Total, ...	713

So that the total area in charge of the Department amounts to 6,266 square miles.

The forests of Hungary are situated in the following zones of altitude :—

Square Miles.		
5,206, or 15	per cent.	below 200 metres (656 feet).
9,935, or 28	„	between 200 and 600 metres (656 and 1,968 feet)
20,318, or 57	„	above 600 metres (1,968 feet).
35,459		

Forty-two meteorological stations have recently been established in or near the forests, for the purpose of observing the temperature and degree of moisture of the air, the direction and force of the wind, and the amount of rainfall. The data furnished by these stations are collected and tabulated in the central office at Buda-Pesth. Observations recorded at altitudes varying from 16 feet (Fiume) to 2,526 feet (Fajna in Mármaros) show that, in 1884, the maximum rainfall amounted to 63 inches (Fiume and Goszpics, both in the south) ; while the minimum, 4 inches, occurred at Petrozsény in the east. The maximum temperature rose to 100° Fahr. at Szolnok in Lower Hungary ; and the minimum, 23° below zero Fahr., was registered at Szepes-Iglo in the north, at an altitude of 1,525 feet. The highest mean temperature, 59° Fahr., was at Zeng, and the lowest, 40° Fahr., at Fajna in Mármaros.

The forests are thus classed, according to the quality of the soil on which they grow—

	Square Miles.
Purely forest soil, as above defined, ...	.. 28,505
Soil adapted for other uses, ...	.. 4,785
Plantations on moving sands, ...	.. 420
Forests of Protection, ...	.. 1,749
Total,	.. 35,459

It is said that the various species of trees are found in the following proportion, *viz.* :—

	Per cent.
Oak (*Quercus pelunculata* and *Q. sessiliflora*),	22·23
Oak (*Q. cerris*), ...	.. 5·72
Beech (*Fagus sylvatica*), ...	.. 35·54
Hornbeam (*Carpinus Betulus* and *C. orientalis*),	.. 9·13
Birch (*Betula alba*), ...	.. 2·39
Carried forward,	.. 76·06

	Per cent.
Brought forward,	76·06
Poplar (*Populus alba, P. canadensis, P. nigra, P. pyramidalis, P. tremula*), ...	2·38
Willow (*Salix alba, S. Caprea, S. fragilis, S. purpurea, S. triandra, S. viminalis*), ...	
Ash (*Fraxinus excelsior* and *F. Ornus*), ...	1·52
Elm (*Ulmus campestris, U. montana, U. suberosa*), ..	
Maple (*Acer campestris, A. platanoides, A. Pseudo-platanus*),	
Alder (*Alnus alpina, A. glutinosa, A. incana*), ...	0·47
Acacia (*Robinia Pseudo-acacia*), ...	0·39
Lime (*Tilia argentea, T. grandifolia, T. parvifolia*), ..	0·09
Spruce (*Abies excelsa*), ...	13·81
Silver fir (*Picea pectinata*), ...	3·31
Scots pine (*Pinus sylvestris*), ...	1·91
Larch (*Larix europæa*), ...	0·06
Total, ..	100

The following trees and shrubs also occur in the forests, but not in sufficiently large numbers to be mentioned separately in the above list:—*Quercus pubescens, Q. hungarica* v. *conferta, Castanea vesca, Corylus Colurna, C. avellana, Sorbus Aria, Prunus spinosa, Juglans nigra, Platanus orientalis, Morus nigra, Rhus Cotinus, Cornus sanguinea, Pinus austriaca, P. Mughus, P. Cembra, Juniperus communis, Taxus baccata.* Experiments with a view to the introduction of certain foreign species have been made in the State forests.

The areas actually covered by the principal groups of species are as follows, *viz.*:—

	Squre Miles.
Oak, ...	9,930
Beech and other broad-leaved species, ...	18,761
Conifers, ...	6,768
Total, ..	35,459

The following table shows the area occupied by each of the principal groups of species in the State forests, and their distribution throughout the three zones of altitude:—

	Oak.	Beech and other broad-leaved Species.	Conifers.	Total.	No. of permanent Springs.
Metres. Feet.					
Plains, 0 to 200= 0 to 656,	515	310	1	826	100
Low hills, 200 to 600=656 to 1968,	380	906	92	1,378	1,002
Mountains above 600=above 1968,	51	1,734	1,564	3,349	11,861
Total square miles,	946	2,950	1,657	5,553	12,963

Management and Working.

Previously to 1848, when the feudal system still prevailed in the country, the Hungarian forests were, generally speaking, valued almost solely on account of the game which they harboured. They were very little worked, and their revenue was merely that obtained from grazing, from the collection of acorns, and from the sale of firewood; timber was used exclusively for local purposes. A few forests only, situated either near rivers, such as the Danube, Tisza, Garam, Vag, and Arva, or around mines and smelting furnaces, or in the neighbourhood of large towns, yielded any considerable income to their owners. After the year 1850, when the feudal system had ceased to exist, the situation was extremely unfavourable to proprietors of land, who, a few years later, when, in consequence of the extension of railways, new markets were opened, tried, without thought of the future, to realise as much as they could from their forests, the importance of maintaining which they failed to understand. They did not, in most cases, possess the capital required to work them on their own account, and they therefore farmed them out, on from five to ten years' leases, to merchants and contractors, whose sole aim was to get the timber out at a cheap rate. The proprietors were unacquainted with the prices paid for wood in the market; they would not incur the expense of having their forests properly valued, and were ignorantly satisfied if they received considerable sums of money for forests of large extent, even though the rates paid to them were ruinously low. The first merchant who come carried off the finest timber, those who followed him taking, each in succession, his choice among the best of the trees which remained, and paying still smaller prices.

In this manner the wood was cleared out of the more accessible forests by slides, canals, and streams, and they rapidly became denuded; while the large quantity of waste-wood, resulting from a too prodigal felling for large timber, brought about a depreciation in the price obtainable for firewood in other forests. In consequence of this, and of the general absence of communications in the country, which caused the timber over the greater part of it to have little or no value, a large proportion of the best oak forests were ruined by continued grazing, and were reduced to the condition of forest pastures and acorn grounds; indeed, in many instances there was little left in them but old stumps; and where the cattle permitted the growth of young trees, the ground was taken possession of by beech and hornbeam. At the same time, valuable beech and pine forests, extending over thousands of acres, were cut or burnt down, with the deliberate object of turning them into

pastures, which were then considered to have more value than forests yielding no revenue. The oak forests will now gradually be restored ; but very few of them, except in Slavonia, can be worked for a long series of years. It was formerly the practice to permit grazing during the fellings and the years immediately succeeding them, and numbers of cattle were bred who passed their whole lives in the forests ; it must therefore be considered a fortunate circumstance, that, after the valuable trees were felled, a crop of shrubs was able to spring up here and there and afford some shelter to the ground.

Subsequent to the year 1850, an inconceivable amount of harm was done, the forests near the principal lines of export, or situated in the vicinity of towns and manufactories, having been worked far too heavily. At this time also, forests of large extent were conceded to communes, who, not sufficiently understanding their value, destroyed them ; and the timber and even the soil of many forests, the property of joint owners, was sold by the co-proprietors, who preferred the small sum of money they could then raise on them to the permanent revenue they might ultimately have obtained under the more favourable conditions of the future. Considerable areas also were cleared for cultivation, and the result was in many cases disastrous ; as for, instance, along the banks of the Danube, the Tisza, and the Temes, where formerly fine oak forests grew, but the ground is now occupied by marshes. A recent case of this kind occurred near Arad, on the Maros, where, the forest growth having been cleared away, the soil rapidly deteriorated, and is now fitted neither for agriculture nor for forest.

Owing to the above causes, the condition of the forests, especially those which belong to communes and private proprietors, is at the present time very poor—excessive felling, imperfect regeneration, and uncontrolled pasture having led in many localities to the most melancholy results ; as witness the shrub forests on the higher mountains, the moving sands of the Alföld or great plain lying between the Danube and the Tisza, and the stony avalanches of the Karst between Trieste and Fiume, where the soil, when protected by forests, was extraordinarily fertile, but now the limestone rocks have been completely denuded ; and if the country is to be allowed even gradually, to recover itself, the exclusion of cattle, sheep, and goats from the whole area, by successive blocks, is an absolute necessity.

But although, on the re-establishment of a constitutional Government in 1867, matters began to mend, little real progress was made until 1879, when the present Forest Law was passed. This not

only ensure the proper management of the forests, but regulates the floating of loose logs and timber rafts, as well as the transport of forest produce by land, thus protecting both the owners of forests and the timber merchants, as well as the persons through or over whose property the produce passes; and the forests are now under proper control throughout the entire country.

The old way of working was not one calculated to develop a good system of sylviculture; but now, as the forests become thinner and wood dearer, mountain sides being denuded and river banks undermined, the necessity for the early introduction of a better system is realised, and people begin to appreciate the new law, which, if it came at the last moment, did not come quite too late; and under it a good and certain forest revenue may still be looked for.

The excessive fellings practised between 1850 and 1880 so reduced the stock of timber in the forests, that they have not now, with comparatively few exceptions, sufficient to enable their rational management to be at once undertaken. It has been calculated that the stock remaining is not more than two-thirds of what it ought to be, and a due proportion of age-classes is rarely found. On the other hand, however, in about one-fifth part of the entire area, the forests which here consist principally of beech, but partly also of conifers, cannot yet be worked on account of the absence of export roads, which, in many cases, it will not at present pay to make; and these forests will, as they are gradually opened out, supply the home and foreign markets for some years to come. The statement, then, which is often heard, that there is still a great stock of wood in the forests, is only true regarding parts of them. It is said that in the State oak and fir forests, the stock of timber falls short of what it should be by 575 and 649 millions of cubic feet respectively, while in the beech forests the stock is in excess by 1,013 millions of cubic feet; and the condition of the forests owned by other proprietors is certainly not more favourable than this. The all-round density of the forests is probably not more than from 6 to 7, and the younger age-classes, where they exist, are, generally speaking, in an unsatisfactory condition. It used to be the custom to sell, in addition to the ordinary fellings, the ash, elm, maple, and other species found scattered here and there throughout the forests, and on this account it is now very difficult to obtain wood of these kinds at reasonable prices.

Until recently, then, rational treatment was, especially in the communal and private forests, almost completely neglected. Now the forests are managed as high forest, coppice, or coppice with standards, in the following proportion, *viz.*:—

	Square Miles.
High forest, with a revolution of 80 to 120 years, extending in rare cases, to 160 years in the oak forests, ...	25,367
Simple coppice, 10 to 60 years,...	10,028
Coppice with standards—standards 80 to 120 years, coppice 20 years, ...	64
Total, ...	35,459

In the State forests the proportion is as follows, *viz.*:—

	Oak.	Beech and other broad-leaved Species.	Conifers.	Total.
High forest, ...	924	2,795	1,493	5,212
Simple coppice, ...	18	70	...	88
Coppice with standards, ...	2	1	...	3
Forest of Protection (selection method), ...	2	84	164	250
Total square miles, ...	946	2,950	1,657	5,553

Regeneration by natural means is resorted to as far as possible; but both early and late frosts are very frequent, so that a crop of seed cannot be looked for oftener than once in five years, and since the year 1880 regeneration by planting or sowing has been largely practised. During 1884 the following areas in the State forests were regenerated by natural and by artificial means respectively, *viz.*:—

		Square Miles.
Natural, ...	...	26
Artificial, { Sowing	8	
Artificial, { Planting, ...	11	
	—	19
Total, ...		45

The total cost of the sowing and planting work was £4,183, or 6*s.* 10*d.* per acre for sowing and 7*s.* for planting.

The spruce, *Abies excelsa*, is the most important of the conifers found in Hungary. It is, generally speaking, grown unmixed with other species, and the forest is clean-felled, the ground being restocked artificially two years afterwards. The advantages of growing forests composed of a mixture of species has not yet been fully recognised, except in the State forests, where in suitable regions, when the production of large timber is aimed at, it is now

the rule to mix spruce, silver fir, and beech in the following proportions, *viz.*:—

50 to 60 per cent. of spruce.
20 to 30 „ of silver fir.
10 to 20 „ of beech.

There is a great deal to be done in the way of restocking bare ground; the funds hitherto granted for this purpose being insufficient to admit of satisfactory progress being made. But the State gives out plants *gratis* to proprietors of all classes, and nearly 11 millions of them have been distributed during the years 1883, 1884, and 1885. The species principally employed are as follows, *viz.*:—The *Robinia pseudo-acacia*, which grows very rapidly, yields excellent firewood, vine props, and timber of small size; the Scots pine, which is planted out at a year old, but in some districts is without needles for a part of the year, and in the northern provinces suffers much from snow; and the black Austrian pine. The larch does very well in some districts, and considerable attention has recently been paid to it.

In former days, forest management was directed principally to the production of firewood, and this is still the case on many properties. But as soon as the improvement of communications enabled timber to be carried to distant markets, even beyond the national frontiers, and the diminution of stock caused a rise in prices, attention began to be directed to the production of large timber of good quality. During the last ten or fifteen years, however, many young oak and spruce forests have been cut for tanning bark, and a good deal of harm has been done by over-cutting for this purpose.

The minor products are at present confined almost exclusively to grass, acorns, and nut galls; the various industries which in other countries are usually found to flourish around extensive forests not having yet been developed to any considerable extent.

Grazing is, however, an important question, both on account of the large number of cattle and other animals which have to be kept alive, and also on account of the revenue it yields. The forest pastures are very extensive, and their existence is, as has previously been explained, one of the principal causes to which the present bad condition of the forests is attributable. It has been assumed that 1 buffalo, 1 horse, 3 donkeys, 3 pigs, 10 sheep, and 1 goat, each of them require as large a provision as 1 ox or cow—

3 oxen	under 3 years of age	being equal to	2	full-grown	animals.
2 horses	„ 3 „	„	1	„	animal.
2 donkeys	„ 2 „	„	1	„	„
4 young pigs		„	1	„	„
3 lambs or kids		„	1	„	„

And on this assumption, the equivalent of 8,300,000 oxen has to be provided for. But it has been calculated that the non-forest grazing grounds do not, at the most liberal rate of production, yield enough grass for more than 5,300,000 oxen; and as stall feeding is very rarely practised, three millions of cattle have to be provided for in the forests. But if every acre were made available which could, without risk to the crop of trees, be opened for grazing, not more than one-fourth of the three millions of oxen could be properly fed; and this fully explains why the forest pastures are now being ruined by over-grazing, while the cattle are, generally speaking, in very poor condition. Legislation on the subject is urgently needed. People in Hungary, as well as in other countries, sometimes assert that the forests do not suffer from grazing; and they cite examples to prove that they have known very well, and carefully watched for the last 20, 30, 40, or 50 years, such and such forests, which have always been full of cattle, and still continue to exist. But, notwithstanding this evidence, it is certain that, even where forests too heavily grazed over have not disappeared entirely, they have suffered severely in their rate of growth and in the quality of the wood they produce, while their complete disappearance is only a matter of time.

The damage done by fires is not so serious in the north as it is in the south and east, where shepherds frequently devastate large areas by burning them over, in order to obtain fresh pasture for their flocks. Attacks by insects, principally *Bostrichus typographus*, are frequent, especially in the eastern provinces; here also dangerous storms very often occur. It is said that in 1884 the damage done in the State forests alone, by fires, wind, insects, and the like causes, was as follows:—

	No. of instances.		Areas affected, Acres.
Fires, ...	76	Broad-leaved forest, ...	1,693
		Coniferous forest, ...	34
			1,727
Inundations, ...	19	... ...	... 99
Wind, ...	51	(800,000 cubic feet of wood),	... 396
Frost and snow,	7	(88,000 „ „),	... 956
Rats, ...	12	... ...	... 405
Insects, ...	17	... ...	... 3,415
			6,998

In 1867 there were only 1,390 miles of railway in the kingdom, now there is a network aggregating 5,530 miles all over the country; and no less than 18 per cent. of the merchandise carried by goods train, and by the Danube Steam Navigation Company, con-

sists of forest produce. Twenty miles of narrow-gauge railway have been constructed for forest purposes. There are also

4,460 miles of State roads.
23,005 „ Departmental roads.
35,983 „ Communal roads.
1,799 „ rivers and canals which can be used for floating wood.

The State roads are kept in good order, but those belonging to communes are not so. In addition to the above, the State has 148 miles of dry slides, and 65 miles of wet slides, with 93 reservoirs constructed for floating purposes, and holding 175,000,000 cubic feet of water. There are also 62 booms, aggregating 8,040 yards in length.

The floating of timber from the mountain forests to the plains, and thence to the markets, is still largely practised, especially in the Carpathians, where, notwithstanding the huge quantity of timber, principally beech, consumed annually in the maintenance of river banks, the erection of weirs, and other works, this system is considered cheaper than to construct and repair cart-roads, which, as they are not required for other purposes, would have to be paid for entirely from the forest budget. The rates for transport by water are also, beyond comparison, lower than those for transport by road ; and the latter would be enhanced if the large amount of wood now water-borne were to be thrown on to the roads.

These considerations appear to justify the existing arrangements, in spite of the lavish expenditure of wood on works connected with the floating of timber, which must strike with astonishment every visitor to these regions.

When the quantity of snow on the ground does not render this impossible, the fellings are usually made in the winter ; but otherwise they are effected after the snow has melted, say about the month of May, when the sap is beginning to rise. The trees are immediately barked, the top branches being left uncut, so as to draw up the sap from the lower part of the trunk, and thus facilitate its drying. In autumn, the timber is cut up and conveyed outside the limits of the block in which it was felled ; and in the succeeding winter, it is moved down to the river side, so that it may, in the spring and summer, be floated down to the markets. As the works of various kinds which have to be constructed in connection with the floating arrangements are on a large scale, and involve a very heavy outlay, the Forest officers are required to possess a complete knowledge of this branch of engineering.

Sufficient labour is, generally speaking, obtainable among the agricultural population for all ordinary work, such as sowing and planting, sliding, dragging, floating and sawing of timber, making of charcoal, and the like; but should large orders be received for cask staves, or railway sleepers, contractors bring additional workmen from the Austrian province of Carniola. It is customary to farm a portion of the forest produce to the commune, in return for the transport of a certain quantity of wood. The timber floaters are a strong hardy race, whom long practice has taught to work with safety upon the most difficult and dangerous rivers. The original workmen were Germans from the Black Forest; but there are now many "Szekelyek" from Transylvania, and Wallachians, who have learnt the business from the Germans.

A bad feature in the present system is that, partly from long custom, and partly from the prevalence of a false idea, that the standing stock is very abundant, the cutting up and working out of the produce is wastefully conducted, thus causing a loss of from 30 to 40 per cent. of the wood. As the stock of timber decreases, and prices rise, an improvement in this respect will doubtless be effected; and, when the workmen are better trained, much of the present waste will be avoided. The State employs 2,933 permanent, and 19,840 temporary hands. The former, who act as instructors to the latter, are a most useful class; and some colonies of them, founded during the last century, now form prosperous communes on the borders of the State forests.

The rates paid for daily labour are usually from 1*s.* to 2*s.* 6*d.* for a man, and from 3*s.* to 8*s.* for a cart and two horses. But work of most kinds is, as a rule, executed by contract, or by piecework, at fixed rates.

Administrative Organisation.

Before 1881, the direction of all forest affairs was vested in the Minister of Commerce; but in that year it was transferred to the Minister of Agriculture; and at the same time the administration of the forests was confided to a special branch, which was relieved of the management of the State agricultural property, and completely freed from all other work. Within the office of the Minister, forest business is dealt with by the Director General of Forests, who, acting as his delegate, decides, with certain exceptions, all questions that are submitted to him. His office is divided into three sections, which take up matters referring to the State forests, working plans, and inspections respectively. Each section is under a Forest Councillor. Section 17 of the law prescribes that the

proprietors whose forests come under its provisions, must employ the number of managers and guards fixed by the working plan, and this forms the basis of the organisation of the Hungarian Forest Service.

The State forests are now divided into 18 Conservatorships, with an average area of 310 square miles, each of which is controlled by a superior administrative officer, corresponding to a Conservator, who is in communication with the Director General. The Conservator directs, inspects, and controls. His circle is formed by the aggregation of a number of divisions, the officers in charge of which are under his orders. Among his various prerogatives may be mentioned the following, *viz.*:—He can engage subordinates and fix their rate of pay; grant leave within certain limits to persons of all grades employed within his circle; approve of contracts for one year relating to the conversion or carriage of forest produce; and order experiments or purchases of plant or stock to the value of £80. He can also sanction the annual sales of forest produce, in accordance with the tariff approved by the Minister, and order the erection and repair of buildings to the value of £160.

The officers in charge of divisions, of which there are 167, with an average area of 33 square miles, act under the instructions of the Conservator, to whom it is their duty to submit proposals on all subjects relative to the management and working of their forests. Authority in certain matters is delegated to them, and they are not permitted to exceed their ordinary powers except in cases of emergency. The division is subdivided into beats, each in charge of a forest guard. There are 1,272 of such beats, averaging $4\frac{1}{3}$ square miles in extent.

Forests which come under the provisions of section 17 of the law, but are not the property of the State, are managed under the authority of the administrative committees of the 64 departments and 14 free towns into which Hungary is divided; and each of these acts through a sub-committee of three members, chosen either from its own body or among other persons skilled in forest business. The State exercises control over the actions of these committees by means of inspectors, of whom there are 20 in Hungary, each having two or more entire departments assigned to him. The committee has power to decide, in accordance always with the provisions of the forest law, all questions that are from time to time submitted to it by the communes or other proprietors; but it is compelled to take the advice of the Inspector, subject to an appeal either by them or by him, in case of disagreement, to the Minister of Agriculture. In urgent cases, the Inspector, as

the minister's representative, has power to stop fellings or other operations which he considers detrimental to the forests; and in such cases the administrative authorities and local police are bound to support him. In case the committee habitually fails in its duty, the minister can replace it by a State Commissioner; and this has once been done. The 20 Inspectors, with their 20 assistants and offices, cost the State £8,932 in 1884, and £9,360 in 1885. The supervision exercised according to law by these officers is not at present liked by the proprietors, especially by those among them who desire to enrich themselves at the expense of future generations; but the good advice they have received has undoubtedly added many thousands of pounds to the value of their forest capital. Experience continues to show the necessity for the maintenance of the existing system; and the Inspectors are now called upon to redouble their efforts in order to safeguard the public interests, and to correct the errors of the past.

The State will take charge of, and manage through its own officers on behalf of the owners, the communal forests in any department, the administrative committee of which applies for this to be done; and many of the departments have availed themselves of this privilege with the most satisfactory results. Small private proprietors may associate themselves together for the payment of the establishment prescribed by the law; and, similarly, communal forests of limited extent may be grouped together for purposes of management, and the overcharging of their budgets may be thus avoided. But if they neglect to provide, in some manner, the necessary managers and guards, the departmental administrative committee or Minister of Agriculture has power to appoint these officials.

The number and distribution of the superior officers and subordinates employed by the State is as follows:—

	Superior officers.	Subordinates.	Menials.	Total.
Central office, ...	27	...	...	27
Inspections, ...	40	...	...	40
State forests,...	505	1,342	264	2,111
Communal forests managed by the State, ...	12	1	...	13
Higher school, ...	7	...	...	7
Lower school, ...	6	3	...	9
	597	1,346	264	2,207

The superior officers are of the following classes, *viz.*:—

	No.	Yearly rate of Pay, with allowances for lodging, Office, Servants, and Horses.
Officers corresponding in rank with Conservators, ...	28	£172 to £332
Secretaries, ...	5	110 „ 116
Superintendents of Working Plans,	9	115 „ 164
Assistant ditto, ...	2	... 60
Deputy Conservators, ...	27	98 „ 142
Assistant ditto, ...	60	94 „ 106
Sub-Assistant ditto,...	140	76 „ 98
Storekeepers and Paymasters, ...	35	60 „ 84
Engineers, ...	4	84 „ 152
Inspectors of Depôts, ...	13	57 „ 83
Probationers, ...	26	... 44
Apprentices, ...	74	29 „ 38
Doctors, ...	14	51 „ 90
Registrars, ...	8	56 „ 68
Accountants, ...	60	48 „ 200

In addition to their yearly pay and allowances, these officers receive from 25 to 60 loads of firewood, and are permitted to cultivate from 5½ to 28½ acres of land, according to their grade. The pay and lodging allowance of subordinates ranges from £18 to £42 a year; they receive from 17 to 25 loads of firewood, and are allowed to cultivate from 4½ to 5½ acres of land, according to grade. The annual cost of the above establishment is about £93,550, or about 6½*d.* per acre of the forests they manage.

The Inspectors receive as yearly pay, lodging, and office allowance, from £180 to £204, with an additional £80 as travelling allowance.

The Assistant Inspectors receive from £80 to £112, with £56 as travelling allowance.

The scale of pay for officers in the State service corresponds with that fixed, during the last century, for other officials of similar rank; but it is considered too low, and will probably be raised. These officers are entitled to pensions under rules passed in 1885. When necessary, officers and subordinates are accommodated with houses in the forest, the number of buildings erected for this purpose being as follows, *viz.*:—

For superior officers, one to three rooms, ...	69
„ „ more than three rooms, ...	239
For superior officers and guards, ...	867
For guards, ...	680
Offices, ...	27
	1,882

The service of the managers and guards employed under the

departmental administrative committees, is, like that of the State officials, permanent, and under fixed rules. They cannot be discharged except under a prescribed procedure. The great private proprietors usually pay their *employés* at a rate which is from 25 per cent. to 50 per cent. higher than that of corresponding grades in the State service ; but their appointments are not so well secured to them, and they have no regular pensions to look forward to.

In order to obtain an appointment as forest officer or manager in any of the forests which are, by the provisions of section 17 of the Forest Law, under the immediate control of the State, a candidate must be a Hungarian subject, who has completed his studies at the High School, and passed as Bachelor of Letters or Bachelor of Science. He must either undergo the course of instruction at the academy at Selmeczbánya, or pass the final examination there, or be trained in some foreign school of the same class in which all the required subjects are taught. He must then, after serving two years on probation, pass the State Forest Examination, held at Buda-Pesth, for which he cannot present himself unless he is qualified as above. The proprietors of forests which are under the provisions of section 17 cannot employ officers or managers who have not duly passed this examination. Section 37 of the Forest Law provides that no guard can, ten years after the promulgation of the law, continue to be employed in these forests unless he has passed a prescribed examination. He must, in the first place, either pass through one of the secondary schools, and then serve for a year on probation, or he must show himself to be proficient in reading, writing, and arithmetic, and serve for three years on probation ; after one or other of which tests, and as soon as he has attained the age of 24 years, he is eligible to pass the Forest Guards' Examination, held periodically in various towns throughout the country. Guards are permitted to perform their military service after they have completed their course of instruction and probation.

All officers, managers, and guards are sworn in, and they wear a uniform, prescribed, in the case of the State forest service, by the King, and otherwise by the Departmental Administrative authorities. Up to the end of 1884, the following number of officers and subordinates in Hungary had been sworn in :—

Superior Officers.

In the service of the State, ...	318
In the service of other proprietors whose forests are under section 17, ...	695
Ditto ditto are not under section 17, ...	589
Total, ...	1,602

Of these, 449 have passed the State Forest Examination.

Subordinates.

In the service of the State, ...	1,323
In the service of other proprietors whose forests are under section 17, ...	14,593
Ditto ditto are not under section 17,	6,926
Total, ...	22,842

Of these, 690 only have passed the Forest Guards' Examination. About one-third of the entire number of subordinates have other employment in addition to their forest duties. There are 360 sworn superior officers and 2,400 subordinates in Croatia and Slavonia. *Employés* of both grades can prosecute cases of forest offences, and, if they have been duly sworn in, their depositions constitute a complete proof against the offenders.

Private proprietors, whose forests are not under section 17 of the law, can employ whom they please; but their men must be of good character, and sufficiently instructed to be able to do their work efficiently. They have, however, at the present time, very few competent foresters.

(*To be continued*).

A GOVERNMENT GRASS FARM IN INDIA.

In 1882, the late Major General Sir Herbert Macpherson, wishing to improve the means of providing fodder for the mounted corps of the Army, became the lessee of the sides of the Railway line between Allahabad and Sirathi, and of about 500 acres of land in the Allahabad cantonments. This land, which had long been used for grazing, he simply preserved, but the rainfall being favourable, a fair crop of grass, amounting to 25,000 maunds, was harvested. Grass cutting was commenced in July, and it was wished, if possible, to complete the harvesting before the grass seeded. But labour was difficult to obtain during September and October, the season of the *kharif* crop, and, consequently, the harvesting was not completed until much later. The quality, too, of the grass cut was inferior, and some of the hay was condemned as unfit for fodder. Altogether the result of the first year's operations could be considered only tolerably satisfactory from a grass point of view, although the accounts at the end of the year shewed a small net profit.

In the next year, 1883, the area of operations was extended. Nearly all the cantonment lands, or between 2,000 and 3,000 acres,

were leased at an annual rental of Rs. 9,504, and Rs. 5,000 were paid to contractors as compensation for forfeiting their leases. In June, immediately after the commencement of the rains, this ground was ploughed as a preparation for sowing *dúb* grass on it, and fenced in to prevent cattle trespassing on to it. As in the previous year the railway land was leased for Rs. 492, and the grass on it preserved. A portion of the cantonment land was leased out for public grazing, and some of it, chiefly *kánchar* soil, on which it was impossible to grow grass, was leased out for cultivation. By these means the actual rent payable for the lands was reduced to about Rs. 2,000. Large sums were spent on cart roads so as to facilitate the manuring and weeding of the land. Some areas of barren land, upon which nothing was ever known to grow, were treated by what is known as the "gatha-bandi" method, being divided into plots, and each plot surrounded by a small embankment to prevent the rain flowing off the surface. By this method and by deep ploughing and heavy manuring, these areas were soon rendered fertile. On the ploughed land a top dressing of manure, obtained from the litter of the slaughter cattle and transport animals, was put down. Grass was cut in September, but owing to the late rains almost all the first crop was destroyed. As in the previous year difficulties were experienced in obtaining labour during the *kharif*, and cutting had to be continued until February. But as the rains lasted longer than usual, most of the grass was still succulent when cut. Some 15,000 maunds of the coarsest grass from the railway land was passed through chaff-cutters and issued to the transport animals, which consumed it greedily, although they refused it in its former state. Altogether the year's operations resulted in a considerable cash profit.

In 1884 the whole cantonment was added to the farm, the fruit trees being also rented. The railway land was given up, and a more convenient area rented in place of it. By this means the area of the farm was increased by 1,400 acres.

It was necessary to leave a portion of the area for the public to graze their cattle in, and also for cultivation, and one-eighth of the area was set aside to be rented out for these purposes. The sums realized for these lands amounted to Rs. 8,909, which very nearly paid for the rent of the whole area, although all the most suitable land for grass farming was retained.

Ploughing was commenced as before immediately after the rains. A good portion of land was manured, but with the exception of a plot or two, no land was planted with *dúb* grass roots. Experience showed that manuring was more important for grass grow-

ing than ploughing. Some three acres of perfectly barren land which had never yielded anything before, and which had not a blade of grass on it, was covered with manure about 2 inches thick, and without being ploughed, was allowed to remain in that state until the rains, when two luxuriant crops of grass were cut off the area, one in August and the other in October. Land treated in this way with cantonment sweepings yielded four to five crops of grass in the year, and from not being worth 6 annas an acre could have been sold for Rs. 13 an acre.

About 100 silos, each 13′ × 12′ × 6′ were dug in convenient places for storing the grass ; one silo in the centre of every 6 acres of meadow, the crop from this area being sufficient to fill a silo of those dimensions. These pits were filled between July and September with grass cut and thrown into the pits by the cutters, at 9 pies per maund of grass. But for these silos the grasses which ripen in August would have rotted. The construction of roads was continued, and much of the sloping ground was treated by the "gatha-bandi" method with very favourable results.

Grass for hay was cut from the 15th October to about January. A good deal of hay was lost owing to its not having been stacked in properly constructed hay cocks.

During the cold season whenever it rained and it was possible to plough, as many ploughs as could be obtained were put on to prepare the land for the following year's crop, and all manuring was completed before the following June. This proved very advantageous as it was found impossible to prepare all the land at the beginning of the rains.

The year was a very flourishing one in nearly every way. A large profit was made from the fruit trees alone, which rented for Rs. 800 from the Cantonment Magistrate, were let out to various individuals for Rs. 2,100 altogether.

In 1885, in addition to the land rented the previous year, all the encamping grounds about Allahabad were taken over by the farm, at the usual rent which had been realized by the Collectors in previous years, with a view to supplying mounted corps on the line of march with fodder.

The same land was let out for public grazing and cultivation as in the previous years, and Rs. 11,386 were realized from this source. This sum very nearly amounted to the whole rent paid for the farm.

Although a very large extent of land had been ploughed and manured during the winter months, a large portion still remained uncultivated. This was ploughed and manured during the rains,

from about the 18th June, and the land ploughed during the winter was also ploughed over again. Ploughing was completed by the 20th July. No dúb grass roots were planted, a plentiful supply having sprung up all over the farm. Every barren spot was ploughed and thickly manured with excellent results.

Owing to the "gatha-bandis" having been made in the dry season, many breaks were made in them by the wash of water during the rains. But where properly made they proved most valuable on uneven or sloping ground. Land treated in this way, which before was barren, was soon covered with grass, and cotton and castor oil plants sown on the ridges flourished well. On level land they caused considerable loss through the water lodging in the plots and rotting the grass. But the sloping ground, where the "bands" can be employed with advantage should not be ploughed, as the loose fine earth becomes washed away, and there being no moisture, the grass withers before it comes to maturity.

A considerable sum of money was spent in "*bunding*" a ravine to form a lake (now called "Macpherson Lake.") Along the sides of this lake large numbers of tamarind, orange and mangoe trees and bamboos were planted. The old fencing trenches round the camp grounds in the farm were replaced by sowing these trenches with babul seed, so as to form a hedge which, after a little careful pruning, soon formed an excellent defence against cattle trespass.

Weeds appeared in great numbers and soon outgrew the grass. They had, therefore, to be up-rooted at very considerable expense. It was found that the pods of the most abundant weed, the "bharurf," were eaten by camels and goats. These were therefore siloed and given to the bullocks which devoured them. This somewhat reduced the cost of weeding.

Oats were sown on the "kachar" land, (on which this cereal grows well,) for the Battery horses, and was sold at Rs. 3 per maund.

From December 1885 the farm had been placed more directly under Government as regards account. The financial report of the year again showed a very considerable profit.

In 1886 grass cutting for rations and ensilage was commenced on the 1st July. This year after considerable difficulty, and by importing labourers from a distance, the cutting was done at 6 pies a maund of green grass, instead of at 9 pies the rate paid hitherto.

Owing to the rains continuing until later than usual, hay making was not commenced until the 24th September, and was con-

tinued until the middle of December, when the third crop of grass grown was cut.

Oats and various other forage crops, such as carrots, were sown in various places, and when harvested, were issued to the transport animals with very considerable profit.

The grass lands were again overgrown with weeds, and expensive weeding was in consequence necessary. Over 4,000 maunds of weeds were siloed with grass for the bullocks. The worst weeds were used for manure. At the close of the year the profit was again considerable.

The results of the five years' working has been as follows:—

Year of working.	*Yield and fed out to Army horses and Transport animals.*				Net profit on the year's operations.
	Green grass.	Hay.	Miscellaneous crops, oats, &c.	Ensilage.	
	Maunds.	Maunds.	Maunds.	Maunds.	Rs.
1882-83, ...	25,000	...	...	...	1,494
1883-84, ...	10,708	17,394	?	361	6,777
1884-85, ...	51,873	29,046	?	14,571	28,596
1885-86, ...	14,266	56,789	965	?	10,342
1886-87, ...	56,155	19,950	?	24,683	17,837

But the collateral advantages derived from the undertaking have been much greater than those shewn in the above tabular statement.

The value of the cantonment lands have been much enhanced; hundreds of acres of barren waste have been reclaimed, ravines filled up and roads opened out; over 8,000 fruit trees and many hundreds of other trees have been planted throughout the cantonments, and a large park made and enclosed and a lake formed.

From the experience gained in the management of the farm, it appears that the most economical way of cutting grass on a large scale in India is by *weight*, not by area, or by labourers on daily pay. At first 9 pies per maund of green grass were paid to the coolies for cutting the grass, but this was afterwards reduced to 6 pies when the crops became heavier. At the former rate some men earned as much as 12 annas a day.

The weighing takes up a great deal of time, and becomes im-

possible if left until the end of the day, when the cŏolies have finished their tasks. Each maund or bundle of grass should be weighed as cut; the grass cutters' names being written down at the commencement of the work, the Overseer has merely to mark the weight opposite each man's name as each bundle is brought to him by the cutter for weighment. The head Overseer totalling these figures can then pay the men at the close of the day without any delay.

The cut grass should be spread out to dry, immediately, a few coolies on daily wages being employed for this work. The hay should be turned over several times during the day, and at night it should be collected into small cocks to protect it from the dew. In the morning when the sun is hot it should be spread out again until dry, but not left drying long enough to allow all the succulent matter in it to evaporate. With a bright strong sun one full day's drying is generally sufficient, when dry the hay should be stacked into substantially built cocks.

The best time for cutting the grass is in September and October, just when the seed is ripening, but before it has fallen. When the ground is cultivated and the rain sufficient, an early crop of grass will have to be cut in July. This, where there is much rain, will be lost if not "*siloed.*" Well manured lands will give four or even five crops of grass between June and December, and will sometimes yield as much as 500 maunds of green grass per acre in the twelve months.

To obtain a good crop of hay the ground must be carefully cultivated. Grass like other crops requires ploughing, manuring, and weeding. A country plough with bullocks and driver can be hired during the slack season for 4 annas a half day, or 8 annas a full day, and each plough is supposed to turn up about three-quarters of an acre a day. This contract ploughing requires, however, great supervision, as the drivers, to spare their bullocks, will not plough deep if they can avoid doing so. There are three holes at the top of the shaft of the plough. If the first hole is used the ploughing will be deep; not if the others are used. Another trick the drivers have for saving their animals is to tighten the rope, called the "nadha," which connects the yoke with the shaft of the plough.

The best season to plough land intended for grass is during the winter months; advantage being taken of every shower of rain, as the ground, except during or immediately after rain, is often too hard for the plough to break it up. Ploughing during the monsoon rains kills the young grass germinating from the seed

which fell during the previous year, and the benefit of the ploughing does not appear to be obtained until the following year.

Manuring is more important for grass, even than ploughing. It can hardly be spread too thickly. A good crop of grass can be obtained by simply surface manuring about 2 inches deep. Litter from the farm yard, or sweeping, serve excellently well. Barren land ploughed and surface manured with the cantonment sweepings yielded five crops of grass in the year. The manuring should be done together with the ploughing during the winter months. Although it may be thought that the best part of the manure spread during the winter will be wasted, experience shows, that for grass it answers best, because it keeps the land soft during the summer months and shelters the roots of the grasses.

Barren and bare soils are often so hard that they can only be ploughed, while they are softened by the rains. If after ploughing and manuring such lands a crop of gram, which does not require a rich soil, be put down in October, the proceeds will almost defray the expense of reclaiming the land.

Weeding will often be necessary if a good grass crop is required, and will prove expensive; but there is nothing for it but to uproot the weeds. The operation will in the end pay through the improvement of the crop. Captain Wingate, Assistant Commissary General, began the Allahabad Grass Farm in 1882, and carried it on for three years under the orders of that distinguished officer the late Sir Herbert Macpherson. Sergeant Overseer Meagher, who was trained under Captain Wingate, has continued to carry on this grass farm on the same lines with yearly increasing success. The Overseer is described as a man of untiring zeal and energy, of exceptional educational attainments for his class of life, and of the strictest integrity.

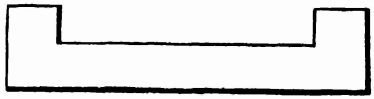
The lesson taught by this singularly successful experiment might, perhaps, be utilized in the Punjab in connection with the so-called Military Rakhs, or areas set apart for providing the troops with fuel and grass, and, indeed, in other cases too.

W. E. D'ARCY.

SLEEPER SLIDE.

DURING an inspection of the Mandi State forests, I had an opportunity of seeing the sleeper slides constructed by Mr. C. E. Fendall, Manager of the Mandi Forest Company, and late an Assistant Conservator of Forests in the Punjab, a short account of these may be acceptable to your readers.

There are two slides, one 6 miles long in the Godwa forests, and the other 4 miles in Godanu. These forests are situated about 20 miles from the Sutlej river, the khud or mountain stream is only workable for sleepers for 14 miles, the problem was how to get the sleepers over the intervening 6 miles. Last year Mr. Fendall erected two small slides about 1½ miles, and their success led him to adopt the same plan. But whereas last year he had utilised sleepers and scantlings (5″ × 4″) in the construction, he could not afford to lock up such an immense number as would be required for 10 miles, so he bought inferior pines and sawed up boards 12′ × 15″ × 3″ and 12′ × 10″ × 3″, the 3 inches was subsequently reduced to 2½ inches. The main idea is the old one in use in the Jaunsar (North-West Provinces) forests, *viz.*, a frame (sikanjá) of form shown, as heavy as possible.

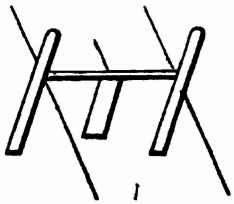


The total length of the "sikanjá" is 30 inches, but this is not constant. In the frame is placed horizontally first the 15 inch boards, and then on each side of it vertically 10 inch boards. Where there is a straight run for the slide, the breadth is reduced from 15 to 13 inches, and even 12 inches, the size of the sleepers being 10′ 3″ × 10¼″ × 5¼″. This is all simple enough, but there are some few little dodges which I think will be usefully recorded here. In the first place plane the edges of the bottom boards, and the inner portion of the side boards where they touch the bottom boards, then drive your wedges home so as to tighten it all up. Then pass a saw down both sides of the bottom board, so as to give it a rough edge; having done this loosen your wedges, ram in moss as tight as you can, and then finally tighten your wedges. Secondly, always have a "sikanjá" in the middle of one length; if this is not put in, you will never get the moss to stay in its place. In bad places have two "sikanjás." In all curves have the outer edge slightly higher than the inner, this tends to make the sleeper constantly slip towards the inner side, saving wear and tear on the outer boards. Thirdly, have as big curves as the ground to be traversed will allow of. A big curve of course increases the length of the slide, and is therefore more expensive, but it is amply repaid by the sleepers not having a chance of jamming. Mr. Fendall tells me he tried the plan of making a slide without any pools in its entire length, and it was a ghastly failure. Have a pool in at least quarter of a mile, and side canals bringing in water wherever they can be erected. Slide-men when hurried are apt to put sleepers into the slide too quickly one after the other. Never allow this,

but let each sleeper get well away with a large quantity of water behind it. In this way you will have less chance of the sleeper being left behind the water. If you have 5 inches of water running into the slide, and the joins are fairly watertight, then two to three sleepers per minute will be a good rate at which to send off, or in great slopes one per minute, so as to allow time for the water to refill the slide after the passage of each sleeper. *Never send a sleeper down a damp slide*, it gets such a pace on that it knocks the slide to pieces, besides being dangerous to the men working about it.

Bunds.—As before noted a pool is required at least every quarter mile to make the bund divert the water so as to run in one small channel, then commence the stone work, filling up all cavities with well rammed earth. Fill up the face of the bund with at least 2 feet of well rammed earth or sods, then shut up the hole you have left for the escape of the water. You will of course have been careful, first of all, to have a stone ready *accurately* fitting the escape hole; if you have not done this, you will have no end of trouble, and the cost of making the bund watertight will be great. Never have the top of the bund higher than the side boards of the slide. Let flood-water pour over the whole of the top of the bund. If you try to imprison it so as to go over one portion, that portion is bound to go, and the gap will tend to constantly increase in width. Make the mouth of the slide where it leaves the bund, 20 inches wide for two joins, and have these two joins *level;* this saves a lot of trouble in sending off sleepers. If water gets low, you can easily diminish the width, *but keep the two joins level.*

Cross Section of "Stop."



Stops.—On very steep slopes use "stops" to break the fearful pace the sleepers get on. Have the bottom board of the slide where the stop bangs after the passage of each sleeper well backed up, and have side guides.

F. O. LEMARCHAND,
Kangra Division.

PINE RESIN IN JAUNSAR.

ABOUT 20 maunds of crude resin have now been subjected to distillation in the chemical laboratory of the Imperial Forest School. Neglecting waste, the result is as follows :—

	Yield in Oil.	Colophony.
Pinus excelsa, ...	22 per cent.,	78 per cent.
Pinus longifolia, ...	18 „	32 „

The crude resin was brought into a copper retort, melted and then heated under admission of a small supply of water. Equal quantities of water and of oil of turpentine began to distil over, the two liquids separating from each other according to specific gravity. The proportion of oil diminished gradually, and when it had been reduced to about one-tenth of the volume of the water, the process was stopped. The remaining liquid resin was poured into an iron vessel and heated briskly to drive out all volatile matter. After cooling, a clear semi-transparent solid resin of amber color (colophony) was left. The oil of turpentine was collected and shaken with water and litmus solution. The litmus became red owing to acetic acid present, and a further shaking after addition of a little sodium carbonate, restored the blue of the litmus, indicating that the oil had been thoroughly freed of acid. This neutral oil was then allowed to stand, and after about four days it became clear and ready for use.

The presence of acid in the crude resin is proved without any doubt. By adding sodium carbonate to neutralize the acid in the distilled water of *Pinus longifolia* resin, I produced a salt which I afterwards treated in a glass retort with strong sulphuric acid. The result was a very pure strong acetic acid.

There is a great difference between the resin of *Pinus excelsa* and of *Pinus longifolia*. The former produced a mere trace of acid, so that a treatment with soda was almost unnecessary. The latter, however, gave a larger amount.

The oil contained at first about $\frac{1}{1600}$th part of acid, and during the ordinary process of distillation, the crystallised soda, which was required to neutralize the resulting oil and water from *P. longifolia*, amounted to about 0·2 per cent. of the crude resin. This implies the presence of about 0·1 per cent. of acetic acid in the crude resin. But on continuing the distillation with water for five days, the acid which distilled over with the water amounted to about 0·25 per cent.

In Sir D. Brandis' N.-W. Forest Flora, page 508, it is said that soda is used in the Punjab during the distillation of oil of turpentine. I mixed soda up to 2 per cent. of the crude resin with the latter in the retort, but this had not the effect of removing the acid. Even an addition of 2 per cent. pure sodium hydrate (caustic soda) to resin, out of which almost all oil and a great deal of acid had already been expelled, did not stop the evolution of acid when the distillation with water was continued. It appears to me impossible to remove the acid in the retort itself by means of a moderate addition of soda.

Yet this would be very desirable, because the acid vapours mixed with some air oxidise the metals of which retorts might be made, iron, galvanized iron, copper. Only tin resists. I was therefore obliged to tin the copper retort and the cooling apparatus, and this had a very good effect. Without this I would not have been able to continue the distillation of the *Pinus longifolia* resin. But the *Pinus excelsa* resin could be distilled in a retort of galvanized iron, there being so very little acid present.

The oil of turpentine of both these trees has an agreeable scent, but much weaker than the oil of turpentine of the trade.

Oil of turpentine and colophony command the following prices, according to information kindly procured by Messrs. Gillander, Arbuthnot and Co., Calcutta.

In England, reduced to Indian weight and coin—

	Rs.
Oil of turpentine, one maund, ...	15
Colophony, one maund, ...	3

The local wholesale prices at Dehra Dún, N.-W. Provinces, are about—

	Rs.
Oil of turpentine, one maund, ...	25
Colophony, 1 maund, ...	5

whilst the actual bazaar retail prices are double this amount.

It is certain that the local prices are higher that those in England, and the local market must first be entirely supplied by Indian product before export can be thought of.

From the yield of oil and colophony given above and the local prices, we obtain the actual value of the products of distillation after deducting about 5 per cent. for waste. The crude resin of *P. excelsa* is then worth about Rs. 9, and that of *P. longifolia* about Rs. 8 per maund of 82⅔ lbs.

A local demand for the colophony has also arisen at the works of the N.-W. Provinces Soap Company, Meerut, which at present uses American colophony.

DEHRA DUN, H. WARTH.
20th November, 1888.

SEEDING OF *PROSOPIS SPICIGERA.*

I NOTICED while examining a forest this morning, that there were seeds on a few khandi (*Prosopis spicigera*) trees. I am told that this is the third time the trees have seeded this year, a circum-

stance never known before in this part of India. Perhaps some of your readers may have seen or heard of this, in which case I should be glad to know to what they attribute the cause. I may mention the season has been a poor one, most of the trees not having had any water.

The bamboo, by a marvellous provision of nature, is known in some parts of India to seed only in times of drought or famine, when the seeds become an article of food, and it occurs to me that it may be the same with khandi, the seeds of which are sometimes pounded into flour and eaten.

17*th November*, 1888. G. E. M.

FOREST CONSERVANCY.—A Behar correspondent writes :—

That forest conservation is absolutely necessary in India no one can deny. Forest laws must be rigid to be of any use, and the Government is to blame for teaching the cultivator to howl about forest oppression. Forests, though a great good, are necessarily accompanied by some evils to the possessors of *jotes* in their vicinity. Government takes up land for railways, canals, &c., and cases thus occur in which individual hardship is inflicted, but this cannot be helped. Forests will eventually be appreciated by the bulk of the population, and it is only Government that can carry out a thorough forest conservation policy. In the wind-scorched and dried-up plains of Behar, forests are as valuable as they are difficult to preserve. In some portions of the Kaimins, Government has estates on which spasmodic attempts at conservation have been made, but in such places buffalo grazing is allowed to go on all the year round, and this is absolutely fatal. The *goala* with his axe and his buffalos does more harm in a year than the cultivator does in ten. The policy of the Bengal Government lets a great deal of the forest difficulty slide. Local officers deal with it according to their personal inclinations. One sees what should be done and tries to do it, but is transferred before his work is well begun. Another does not care for forestry, and the bother of having anything to do with it. He takes advantage of the howl against forest oppression, lets the matter slide, and works up his own particular hobby, local self-government, education, municipalities or sanitation.—*Englishman.*

JJ. Review.

FOREST CONSERVANCY IN THE CENTRAL PROVINCES.*

We regret that the important work our Department is doing in the Central Provinces should only be noticed so late, although the Government of India resolution on Colonel Doveton's report is more than a year old, but our excuse must be that there are only twelve numbers of the "Indian Forester" published during the year, whilst there are thirteen Annual Forest Reports, including that of the Forest Surveys, to be noticed.

Work in the Central Provinces has proved beyond the powers of the present establishment, and it is evidently time that this large Circle should be sub-divided, and that the Divisional officers should be assisted by a strong staff of trained subordinates, and we gather from the remarks of the Government of India, that the necessity is fully recognized, and that it is confidently expected that strengthening the establishments will result in better financial results than those now shown, whilst the framing of Working Plans for the forests of the Central Provinces has been already too long delayed for want of officers.

The experience of the Government of India, is that whenever a Working Plan has been formed, it has always resulted in an immediate increase of net, as well as gross, revenue, and this points to the very careful manner in which Forest officers throughout India have been managing their forests, although every inducement to make revenue the chief object in view is held out to them.

The total area of the reserved forests in the Central Provinces is 19,955 square miles, or 24 per cent. of the area of the Province, and there are 404 square miles besides of unclassed State forests.

The 521 square miles added to the area of the reserves since last year is all due, except about one square mile, to correction of discrepancies in the recorded areas, and as the Forest Survey is now getting to work in the Central Provinces, more errors in the records, due to their being based on mere estimate, will doubtless come to light.

* Progress Report of Forest Administration for the Central Provinces in 1886-87, by Colonel J. C. Doveton, with the usual Government orders.

The forests of each district are now being classified, as follows :—

(1). Those to be permanently maintained and requiring strict conservancy.

(2). Those to be permanently maintained, but requiring less strict conservancy.

(3). Forests available for the extension of cultivation.

The boundaries of the reserves are stated to be in good order, and a record of them is to be prepared in conjunction with the approaching surveys.

The number of cases compounded and taken into court, 6,686, or roughly one for every 3 square miles of reserved forest, has fallen by over 2,000 as compared with the figures of the previous year, but it is stated that some cases have been injudiciously undertaken in the Betal district.

Regarding fire protection, 1,441 square miles, or 8 per cent. of the reserved area, have been successfully protected, at a cost of 4 pies per acre, whilst the failures have been 125 square miles, the protection of 122 square miles in excess of that attempted last year having been undertaken.

Colonel Doveton remarks, that in the forests of the East Pench range of the Seoni Division, the fires passing through the forest has had no appreciable effect on the forest growth, saplings and seedlings not having been injured, and no harm having been done even to the foliage, which was starting at the time of the fire. This is said to be due to the decrease in the amount of inflammable matter resulting from continued fire-protection.

The Government of India has enquired whether landowners provide grazing on their own lands, in accordance with the land settlement, and whether the grazing fees, which are said to be lower in the Central Provinces than elsewhere, cannot be raised and graduated in proportion to the accessibility and value as a grazing ground of each forest.

Under natural reproduction, Colonel Doveton states that, in Bhandara, wherever the Garari (*Lebedieropsis orbicularis*) forms an important element in the forest growth, that the increase of cover on the ground is very marked, and the position for bringing the forests under systematic treatment has greatly improved.

The following remarks regarding natural reproduction will be found interesting :—

"In all the ranges of the Seoni Division where the soil is favourable and where cattle are excluded, there is generally good growth from self-sown seed. In the Korai and Sonawani ranges, bamboo and saj seedlings

are coming up luxuriantly, and in these ranges, as also in a large area of the East Pench range, tewas and dhaora seedlings are in a prosperous condition. But in the 2nd Class and other forests which are burnt periodically and grazing is not checked, the main reproduction is from stools.

"Regarding the Kuntranala and Hathibari reserves which are under fire protection, the Divisional Officer remarks, that reproduction is good in both forests, and that this is due to fire protection, without which reproduction cannot be expected.

"In parts of the Saonligarh reserve inspected by the Conservator, the reproduction of teak and tinus in open spaces, and beneath such inferior species as salai, moyin and aonla, was found to be excellent.

"In those areas in this Division which are not protected from fire or cattle, reproduction is at the best poor, and though, where there is a fortunate association of species such as teak with other specially protected trees, or with inferior trees for which in the locality there is no demand, the young growth has developed well, in a considerable portion of the teak-bearing area, the teak has suffered from the too extensive cuttings of other species. It is however, hoped that at no distant period these more valuable areas will be subjected to a more rational method of treatment.

"The natural reproduction in open spaces at high levels in the Jagmundal reserve of the Mandla Division was previously referred to in paragraph 69 of the report for 1885-86. The young growth that had then sprung into existence has continued to develope well, and now in the plain portion, except in the one large absolute blank, not only has reproduction been excellent, but the proportion of young trees that have passed into the sapling and pole stage is very large indeed; perhaps the proportion of teak is a little too large, but this is a matter to which attention has been directed and which will if possible be remedied."

Under artificial reproduction, there is little to note, except the planting of evergreens along boundaries and fire lines in the Bowergarh and Khamarpur reserves, while tinus and khair have been sown in the old Bowergarh teak plantation to produce a mixed growth.

As a result of former sowings, it is noted that on 177 acres in the Khamarpur reserve sown in 1877, that there are now 10,400 teak trees averaging 7 feet in height and 6 inches in girth, and many of which have attained a height of 14 feet.

This shows the different nature of the growth of teak in the Central Provinces as compared with Assam, where in ten years, teak seedlings have attained heights of 40 feet and girths of nearly 3 feet.

A good deal of work appears to have been done in the way of climber-cutting, but the record of this work for the whole circle is incomplete.

The cost of climber cutting in the case of 2,000 acres in the northern part of the Korai range, Seoni, was Rs. 102, or about Rs. 33 per square mile. Cutting back inferior teak trees was effected on a small scale in certain forests in Mandla and Hoshangabad, but the large supply of teak poles from private forests prevented this work being greatly extended, and the area operated on is not given.

In the Central Provinces little attention has hitherto been paid to the construction of roads, or of buildings in the forest for the temporary accommodation of officers; Rs. 4,800, or one per cent. of the total expenditure, having been so spent during the year under notice.

The following remarks on the amount of produce removed from the forest are from the Government of India orders on the report :—

Description of Produce.	By Departmental Agency.			By Purchasers.			Total.		
	1st class Reserves.	2nd class Reserves.	Total.	1st class Reserves.	2nd class Reserves.	Total.	1st class Reserves.	2nd class Reserves.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Timber, ...	1,654	777	2,431	10,060	18,584	28,644	11,714	19,361	31,075
Firewood and charcoal,	321	196	517	13,033	65,017	78,050	13,354	66,213	78,567
Bamboos, ...	291	...	291	8,875	4,576	13,451	9,166	4,576	13,742
Grass, ...	442	23	465	5,935	13,832	19,767	6,377	13,855	20,232
Other minor produce,...	157	316	473	812	5,294	6,106	969	5,610	6,579
Total in 1886-87, ...	2,865	1,312	4,177	38,715	107,303	146,018	41,580	108,615	150,195
„ 1885-86, ...	1,908	778	2,686	27,002	127,218	154,220	28,910	127,996	155,906
Increase or decrease in 1886-87,	+957	+534	+1,491	+11,713	—19,915	—8,202	+12,670	—19,381	—6,711

"There was an increase of 1,491 tons in the amount removed by departmental agency, and a decrease of 8,202 tons in that removed by purchasers. The figures are admittedly incomplete, and it is difficult to form a true estimate of what the real results of departmental operations have been. The total amount of timber (other than teak and sál) and of firewood (including charcoal) removed from the Government forests of all classes amounts to only one-sixth of a cubic foot of the former and 20 lbs. of the latter, per head of population. The Government of India is aware that the requirements of the people in this respect are met, to a great extent, from private forests; but I am to say that, in the

opinion of His Excellency in Council, this extremely low rate points to errors in the record, which is admittedly faulty. You explain that two principal causes affect the amount of produce removed from the State Forests of the Central Provinces—*viz.*, *first*, the impulse given to the reckless felling of timber in zamindari and malguzari forests, due to the construction of the Bengal-Nagpur Railway, and the idea possessed by the malguzars that, in consequence of the Settlement operations now in progress, they must seize the present opportunity of making all they can out of their forests; *second*, the weakness of the forest establishments. I am to express the satisfaction felt by the Government of India that the importance of these questions is thoroughly appreciated by you, and that the first of the above-named causes of diminution in the Forest Revenue has your anxious attention. His Excellency the Governor General in Council is gratified to learn that you have taken measures to explain their true position to the malguzars, and also to enforce the clauses of the *wajib-ul-arz* regarding forest matters. In your opinion the facts which have come to light in this connection seem to call for a more effectual remedy than any which the law at present allows. Should you be led to the conclusion that an amendment of the existing legislation is needed, your proposals will meet with full consideration by the Government of India. The strengthening of the permanent conservancy establishments has now been provided for, and it rests with the Conservator to bring about the increase as rapidly as considerations of efficiency will admit of. The question of office establishments will doubtless receive your attention."

The financial results of the year are as follow :—

Year.	Receipts.	Charges.	Surplus.	Proportion of Surplus to Gross Revenue.
	Rs.	Rs.	Rs.	Per cent.
1886-87, ...	9,57,410	4,99,293	4,58,117	48
1885-86, ...	10,36,894	4,45,432	5,91,462	57
Increase or decrease in 1886-87, ...	−79,484	+53,861	−1,33,345	−9

III. Official Paper.

FIVE-YEAR PLAN OF OPERATIONS FOR THE REHAR AND MAKONIA FORESTS.

1. *Situation.*—The Rehar forest is situated in the north-eastern corner of the Bijnor district of the Rohilkhand Division. It lies south of the submontane road between Kalagarh and Rámnagar, and is in the vicinity of the town of Rehar.

2. *Area.*—The area of the Rehar reserve is 15,719 acres; of this 11,531 acres only are under fire-protection, the remainder, consisting principally of grassy plains to the east, is utilized for grazing purposes and for tobacco cultivation.

3. The adjoining Tarái district forest of Makonia is a continuation of the Rehar forest, and for purposes of management is included in the Rehar forester's charge. The area of Makonia is 1,075 acres, of which 838 acres are under fire-protection. The total area of forest for which this plan is drawn up is therefore 16,794 acres.

4. *Boundaries, &c.*—The boundaries of the Working Circle are shown on a map. It is in charge of a Forester with five Forest Guards in charge of the following beats:—Raninagal, Keripur, Amangarh, Murgaboj, and Makonia. It is free of all rights.

5. *Previous management.*—The Rehar forest was made over to the Forest Department on the 1st December, 1879; previous to this date it was managed by the Bijnor district authorities. The more important items of forest produce were formerly annually leased, but since the above date the forest has been worked under the Permit and Revenue Depôt system. It is annually open from November to about 15th February for the export of dry timber and minor forest produce, while some thinnings have also been made, but no regular system of fellings has hitherto been followed. The average revenue realized is from Rs. 1,500 to Rs. 2,000 per annum.

Makonia has been managed by the Garhwál Divisional Officer for the Superintendent of the Tarái since 1882.

6. Protection from fire was started in 1880, and has been con-

tinued since with varying success. The following fires have occurred :—

Year.	*Behar.*	*Makonia.*
1881, ...	9,492 acres.	...
1882, ...	1,980 „	...
1887, ...	3,073 „	...
1888, ...	1,120 „	400 acres.

The areas burnt are shown on the fire-protection maps.

7. *The ground.*—The ground is very irregular. To the west and south it is cut up in all directions by ravines alternating with spurs of high ground which generally run north and south, causing great variation in the soil and stock. To the north and east the ground is more regular, undulating with a regular slope to the south. The elevation of the northern fire-line is about 1,000 feet above the sea, that of the new Banjarihar line 763 feet.

The soil.—The soil in the low-lying ground in the vicinity of ravines and on the plain is good, sometimes sand, sometimes clay predominating ; these alternate layers constitute the normal Bhábar alluvium deposits. The soil is generally moist and well adapted to the growth of sál, which species in the richer portions takes almost entire possession of the ground. Wherever higher ground occurs the soil becomes poor, generally a stiff clay, shallow and dry in character, with frequently a bed of boulders close to the surface. A few very low places are found where water lies more or less all the year at or near the surface, similar, on a small scale, to the *phantas* of Oudh ; they are exposed to heavy frost, and are unsuitable for forest growth, and are always blank. Such are Ram Tal, Phul Tal, and Jamar Kháta.

8. *The stock.*—From the above remarks it may be gathered that the stock is irregular, varying with the ground and soil. The richer portions, and, generally speaking, all the low-lying ground hold soil more or less pure, the best parts consisting of high pole forest holding 100 and more trees per acre. The half-acre sample growth plot, which has been purposely chosen where the forest is not extraordinarily rich, contains 80 trees, of which 55 are sál. A two-acre plot has been selected along-side, and thinned out to 65 trees per acre. The sample plot was selected and first measured in 1887, and the trees are measured every year in March ; the results of the observations should give valuable data regarding the growth of sál in this forest. On the high ground inferior species become more numerous, and on the jutting spurs sál disappears entirely,

the forest growth consisting of bel, ber, khair, tendu, dhak, &c., with numerous blanks. The species most commonly found mixed with the sál are—

Vernacular.	*Botanical.*
Sain, ...	Terminalia tomentosa.
Bahera, ...	„ bellerica.
Hair, ...	„ Chebula.
Paral, ...	Stereospermum suaveolens.
Sandan, ...	Ougenia dalbergoides.
Jaman, ...	Eugenia Jambolana.
Tendu, ...	Diospyros Melanoxylon.
Dhak, ...	Butea frondosa.
Dhouri, ...	Lagerstrœmia parviflora.
Khumbi, ...	Careya arborea.
Kathilawa, ...	Buchanania latifolia.
Bel, ...	Ægle Marmelos.

9. *Reproduction.*—Reproduction is very good in places, but over the north and west of the forest still leaves much to be desired. In the denser portions of the forest, such as hold 90 and more sál poles to the acre, we cannot expect reproduction ; but in the open portions to the south and east reproduction is good ; but to the north, where large tracts of open forest with isolated trees occur, such as compartment J, the young growth is very poor.

10. *Unsoundness of stock.*—The stock is everywhere injured by previous fires, and it is doubtful if there are any sound trees of over 30 inches in girth, as of the numerous trees cut in laying out fire-lines none over this girth have been sound. There are no stumps of large sál to be found in the forest, nor are there any standing trees of any dimensions, say over 5 feet 6 inches in girth. This fact leads up to a doubt whether this forest is capable of producing sound sál timber of large dimensions.

11. *Demand.*—Rehar and Makonia being near the markets and accessible on all sides, there is a free demand for all kinds of forest produce. Sál poles and those of other species command a ready sale, as also fuel and other forest produce. As there has been little green timber offered during the last eight years, there is now a considerable demand for it, though it is doubtful whether the regular annual demand will enable us to sell all the timber which the forest is capable of yielding, and which it is now proposed to utilize.

12. *Communications and markets.*—The forest is traversed by numerous fire-lines, on which excellent cart-roads have been con-

structed, while loaded carts can go almost everywhere through the forest. There are three main roads leading to (1) Ramnagar, (2) *viâ* Amangarh to Jaspur, (3) *viâ* Lalpuri to Rehar, and these three places are the principal local markets. The most important is Jaspur, where merchants come from the plains for timber and take it to the rail at Moradabad. There is also a certain trade in charcoal at Barhionwâla. Barhionwâla is 3 miles, Jaspur 6 miles, and Moradabad 37 miles from Amangarh, a revenue depôt on the south-east of the forest. We cannot, however, depend on this local demand to absorb all the timber available, but must endeavour to enter into contracts with some of the big timber merchants of the plains.

13. *Choice of method of working.*—We have, then, a forest in which the greater part of the most valuable stock at present on the ground is unsound, and which it is desirable to replace as soon as possible with a young healthy growth—a forest in which we are doubtful whether large sound sál timber can be produced, but in which we wish to produce it if possible—a forest where there is a considerable local demand for poles and small timber of most species and also for fuel.

Under these circumstances, it is thought that the best method of working will be strip fellings of coppice under standards. The coppice operations will yield a plentiful supply of poles and fuel. The standards carefully selected will run the best chance of growing into big sound trees, and fellings in strips is, it is hoped, the most likely method to ensure successful natural reproduction, as the young growth will be protected from frost, &c.

14. *Preparation of stock map.*—With these ends in view a map showing the distribution of the stock has been prepared. As the work had to be carried out by the ordinary forest establishment, in addition to their own duties, nothing very elaborate could be attempted. The method adopted was as follows :—The grassy plains and mixed forest unprotected from fire were excluded as unworkable. In the fire-protected area lines were run straight through the forest east and west, parallel with the new Banjarihar line, and to each other at a distance of a quarter of a mile apart. Lines 17 to 22 were taken half a mile apart, the increased distance being given to save time, and because the forest growth is uniform and easily classed. Along these lines distances were carefully chained and the class of forest met with was noted and plotted on to the map. These lines are indicated by white paint and blazes on the trees, and each line has its proper number posted up at the outer boundary

and wherever it cuts an interior fire-line. A series of lines north and south up the fire-lines and main nálas were in like manner classified and noted on the map. By connecting the zones of growth thus obtained, and with the aid of the local knowledge of the Divisional Officer, the Range Officer, Forest Ranger Chintamani Joshi, and his subordinates, a fairly accurate stock map has been prepared. The classes adopted are—

A. Where sál is the dominant species of the stock.

B. Where sál forms but a small part of the stock, *i. e.*, roughly, less than half.

C. Mixed forest containing little or no sál or grassy plains.

The variations of the stock in class A were also noted and divided into four sub-classes, which it was intended to show on the map, but the changes are so frequent, and the forest so irregular, that it has not been possible to do so satisfactorily; the note-book, however, shows the state of the forest at any point on the various lines.

15. The result of this work gives—

Area of class A, ...	7,991	acres.
„ „ B, ...	450	„
„ „ C, ...	3,928	„
Mixed forest and grassy plains unprotected from fire, ...	4,425	„
Total area of working circle, ...	16,794	„

16. *Proposals for working the forests. Treatment of class A. Area and division of the forest into compartments.*—Treatment of class A, area 7,991 acres. It is proposed to fell over the whole area of class A in coppice fellings with reserved standards. Twenty years is proposed as the revolution: at that age the young coppice growth may be expected to yield a plentiful supply of poles and fuel. The approximate area of class A to be annually felled over will thus be 399 acres. The fire-protected or valued area of the working circle has therefore been divided into 11 compartments, 10 containing areas of class A as nearly equal as can be arranged, due consideration being given to the richness or poverty of the stock, and the areas reduced or increased accordingly, in order, as far as possible, to provide for a stable annual outturn; the 11th compartment, K, is excluded on account of its poverty.

17. *Description of compartments.*—A rough description of these compartments is given in an appendix.

18. *Area table of compartments.*—The following Table gives the area of classes A, B, and C in each compartment:—

Compartments.	Total area.	Area of B and C.	Area of A.
	Acres.	Acres.	Acres.
A, ...	889	156	733
B, ...	918	119	799
C, ...	1,282	524	758
D, ...	823	179	644
E, ...	1,117	260	857
F, ...	1,185	573	612
G, ...	1,420	502	918
H, ...	1,643	414	1,229
I, ...	968	304	664
J, ...	905	128	777
K, ...	1,219	1,219	...
Total, ...	12,369	4,378	7,991

Unvalued area not included in above, 4,425 acres.

19. *Plan of fellings for next five years.*—The following proposals are drawn up for the next five years, and at the expiration of this term it is proposed the plan should be revised and amended as may be necessary. The compartments will be worked over in the above order. The entire area of class A will be felled over in strips, leaving 20 to 30 of the best standards of sál per acre and a few of the best grown of other species; these standards should not be more than about 20 inches in girth, or the probability is they will be unsound.

It may be thought that 30 standards per acre is too many to reserve, and no doubt the coppice growth may be somewhat retarded by leaving so many; but it has been noted that where young standards are suddenly deprived of their companions and isolated they frequently die. The Dhikala sample plot affords an instance of this, where several young sál trees left by themselves in the open have dried up; moreover, the trunk becomes quickly covered with branchlets which eventually spoil the tree. Lastly, in the Rehar forest, frosts are frequent throughout the cold season, and for this and the previous reasons it is deemed advisable to reserve not less than 20 standards per acre. The effects of the standards on the coppice growth and reproduction should be carefully noted. The average height of the trees in the best portions where it is proposed to fell, is 50 feet to 60 feet, and three times the height of the trees should be the best width for the strips. The compartment to be worked will be treated as follows:—

The strips will be laid out north and south 150 feet in width and running the entire length of the compartment; alternate strips will then be cut over, every second strip being left for the 2nd rotation of the fellings. In this way half of each compartment will be cut over in alternate strips every ten years. The fellings should be made north and south, because, the prevailing winds being westerly and often of considerable violence, the standards reserved and young coppice growth will be better protected by the intervening strips, and also the felled strips will receive a more abundant supply of seed which will be blown all over them.

20. *Time of felling.*—The working season is a very short one, being from 1st of November to about the 15th February (when the forest has to be closed owing to danger of fire), so we have no choice of time for felling; the trees must be felled early in November.

Manner of felling.—A main object of these fellings being to produce a good coppice growth, it is important that the trees be felled close to the ground and with the axe. If found practicable, the stumps should also be trimmed with an adze.

21. *Trees near ravines.*—No trees on the banks of ravines must be felled, none, say, within 6 feet of either bank.

22. For the first year at any rate, such trees as are fit for timber should be selected and felled by Government agency, collected on the nearest cart-road and sold there by auction; when only stuff fit for fuel and charcoal is left, the cutting and export at fixed rates can be left to the merchants, care being exercised that the trees are cut as close to the ground as possible.

23. It will doubtless be found at the time of working that portions of forest classed A approach class B and C in character and are not adapted to this mode of working, or the forest will occasionally be too open, and it may not be found advisable to materially reduce the stock on the ground. In such cases the area should be gone over as above in lines north and south, but the fellings should be simply improvement fellings, taking out all unsound and deformed trees and any trees that are interfering with the growth of young healthy sál.

24. *Treatment of* B *and* C.—The area of B, 450 acres, is too small to be worked separately, and it is preferable to treat classes B and C together, *i.e.*, 4,378 acres. This joint class consists, as already noted, of poor open forest of bel, khair, tendu, &c., with much high grass and many blanks, while reproduction is scanty. The improvement of this area must be left mainly to nature and will be a work of time. The principal agent to trust to will be

successful fire-protection; but at the time each compartment is worked over the portions of B and C contained therein should be gone over as carefully as possible, and the few sál existing be helped on by removing any tree that is keeping them back; in the same way promising trees of other species should be helped, if possible. There is, however, but little to be done in this way at present; creepers will be cut as provided for later on, but until the effect of fire-protection becomes more marked, nothing further is recommended for this joint class of forest.

25. *Treatment of compartment* K.—This compartment, area 1,219 acres, has been excluded from the scheme of working, as it contains next to no sál. It has been classed entirely as C. It should not, however, be left quite uncared for; as opportunity and funds are available it should be gone over gradually, improvement fellings made where possible or necessary and creepers cut. It should all be gone over in this manner during the next five years.

26. *Treatment of grass lands and mixed forest unprotected from fire.*—The forest area not under fire-protection consists of grassy plains on the Baneli Rau, a narrow strip of poor mixed forest between the submontane road and the northern outer fire-line and grass lands with patches of forests between the Phika nadi and the eastern fire-line. These will, as at present, be utilized for grazing purposes and for tobacco cultivation, and no change in their treatment is suggested. The extension of tobacco cultivation at Jhulon should be encouraged, and the old fields south of Koti Rau might be utilized for the same purpose. Leases for collection of gums and honey might also be given.

Works of Improvement.

27. *Works of improvement.—Fire-protection.*—Every effort to continue successful fire-protection should be made. The forest is well divided by fire-lines, and nothing more is required save that the Peli Ram Tal line should be extended in the same straight line to the eastern outer boundary. Some better style of huts should be made for the accommodation of the fire patrols. Mud huts with thatched roof would cost about Rs. 40 each, and will be a great improvement on the present grass huts, which afford little protection in the hot weather. These huts will also be useful for the Forest Guards. They should be built at Sarniwála, where the forest boundary leaves the Baneli Rau, at Lálpuri, at Kirpachájpur, at Koti Rau, at Dewanandpurgarhi, and at Jhulon.

28. *Creeper-cutting.*—Creeper-cutting is a most important work

and must be pushed on. The creepers in this forest are numerous and most injurious to sál, &c. Much has already been done, about one-third of the fire-conserved area having been gone over. As it is now proposed to undertake regular fellings, they must be preceded by regular creeper-cuttings, and creepers should be cut at least two years before the forest is felled over, while in each compartment creepers should be re-cut after three years. To bring this plan gradually into practice, the cuttings will be arranged as follows during the next five years. Many of the compartments having been cut over in whole or in part, the work will often be a second cutting :—

1888-89,	compartments	A and B.
1889-90,	„	C and D.
1890-91,	„	E and F.
1891-92,	„	G and H and 2nd cutting over A and B.
1892-93,	„	I and J and 2nd cutting over C and D.

The creepers should be cut close to the ground, or better still a little underneath it, and the root smashed with the axe to check shoots. They should also be cut so that no parts of the stems cut rest on the ground, or they will probably throw out new roots and manage to survive.

Boundaries.—The boundary of the Rehar reserve is satisfactorily demarcated. It has not, however, been finally passed as correct by the district authorities, and an objection to the boundary near Amangarh is now pending. This should be settled as soon as possible, and the boundary of the whole reserve be passed as finally correct. As regards Makonia, such of the boundary as runs with village lands is very indefinite and unsatisfactory. This boundary should be at once attended to and permanently laid down with ditches and pillars.

If the present fire-lines of Makonia can be accepted as the permanent boundary it would be satisfactory.

F. B. BRYANT,
Offg. Dy. Consvr. of Forests, Garhwál Divn.

Sanctioned for five years from 1888-89.

C. BAGSHAWE,
Offg. Consvr. of Forests, C. C., N.-W. P. and Oudh.

NAINI TAL :
The 24th September, 1888.

IV. Notes, Queries and Extracts.

Discovery of Fossil Trees near Glasgow.—The wonderful geological discovery in one of the western suburbs of Glasgow has excited widespread interest, and has been pronounced by leading scientists to be one of the finest collections in Europe. Some years ago the Commissioners of Partrick leased 40 acres of ground at the west end of Whiteinch, and this land has since been converted into a public park for the burgh. In the ground leased was an old quarry, which had been used as a receptacle for rubbish. It had once been a wooded eminence; but the manner in which the stones had been taken from the quarry had the effect of dividing it into two elevated plateaus, with rocky and precipitous sides. It was seen that this would make an admirable retreat from a broiling sun, and the Commissioners took steps to lay it out to the best possible advantage. In January last, while a carriage-way was being cut through the quarry, one of the workmen called the attention of the foreman to a peculiar "ring" in the stone. It soon became evident that a "fossil tree" had been discovered, and later there were exposed the twisted and warped roots, as if they were living and growing. As the schist was cut through, other "rings" were bared; and now, after seven months of careful excavation, nine perfectly rooted trees with erect stems have been discovered, while two other "fallen trees"—also solid stone and perfect in shape—with several fine branches have been further exposed to view.

The circumferences of the different trees at the thickest part of the stem are given as follows:—

1	11 feet 4 inches.	1	6 feet 8 inches.
1	8 „ 10½ „	1	6 „ 6 „
1	8 „ 7 „	1	6 „ 4 „
1	8 „ 6 „	1	5 „ 3 „
1	8 „ 1 „		

The trees vary in height from the root upward from 1 foot to 3 feet, all having been broken off where the schist ends and the sandstone begins. One fallen tree, lying at an oblique angle to the erect trees, measures 18 feet 10 inches, while another huge one, only

partially uncovered as yet, lies longitudinally, and is about 4 feet diameter. The floor on which the fossils stand measures 64 feet by 25 feet.

As to the generic identification, some difficulty seems to be experienced. While some experts state that they are *Sigillaria*, and the roots *Stigmaria*, there are others who say they have more the character of *Lepidodendrons* than of *Sigillaria*, and even did they belong to *Sigillaria*, it must be the *Clathrate* group. Mr. John Young, who, in conjunction with Mr. D. C. Glen, prepared a paper on this subject for the Glasgow Geological Society, is of opinion that these trees are of a tremendous age, older than the human race to which they just have been revealed; older indeed than animal life of any kind, save, perhaps, a form of leech or earthworm, traces of which have been met with in the surrounding strata. He regards the strata they now stand in as a "portion of the fossil coal and ironstone series," and believes that these trees have been covered with 3,000 feet of strata which, after being laid down, has again been reduced to a few feet by denudation. In a paper read to the Glenfield Ramblers at Kilmarnock, the Rev. D. Landsborough says:—"The forest now revealed is to Scotland what Pompeii is to Italy—only Pompeii is a thing of yesterday in comparison. . . . . We listen to the birds singing in the branches of the grove which now over canopies it, and we gather flowers under their shade, but no bird ever sang or flitted amongst the branches of that old forest, flowers did not grow under their shade, nor did the foot of man, or even of a single quadruped, ever tread its sward. How dark, silent, and solitary must the old forests have been."

The Commissioners have taken the necessary steps to protect the interesting and instructive sight, and daily numerous visitors are attracted to the spot.—*Timber Trades Journal.*

KAWRIE PINE.—The destruction of timber seems to go on in New Zealand more wantonly than anything we have heard of in the pine forests of America, some instances of which are mentioned by Mr. Froude in his *Oceana* 1886. Travelling from Auckland to visit the Maori Reserve, about 160 miles to the south of the capital, he stops at two towns named after our universities Oxford and Cambridge, and at pages 229-30 in that interesting work we find the following scenic description:—

"We stopped at Oxford only to change horses. A few miles further on we crossed the land of the Maori, and plunged into

20 miles of unbroken forest—a forest which was a forest indeed —trees all new to me, from 160 to 200 feet high, many of them reminding me, in form and character, of the Australian gum tree, with which, I believe, they have no affinity whatsoever; as if air and climate tended to produce the same colours and outlines in organisms entirely distinct. The kawrie pine is the grandest of the New Zealand forest princes. He stands alone, allows no undergrowth beneath his shade, and clears an open space about him. A track had been cut with the axe for the road on which we were travelling, permission being purchased from the Maoris to whom the wood belongs. Thirty feet or so had been cleared on either side of the carriage way to let in air and light, and the vast trunks lay stretched as they had fallen one upon another, thousands and tens of thousands of the finest timber, left to rot; nay, not even to rot, for they had set them on fire where they could, and the flames spreading to the forest had seized the trees which were nearest, and there they were standing, scorched, blackened, and leafless: we went through absolutely twenty miles of this. Such lavish and wanton destruction I must have seen to have believed. The Maoris are too indolent to use the timber, and too careless to sell it; the white colonist can get as much as he wants elsewhere. It was too painful to look at, and it was a relief when we emerged into open land and sunshine."

It is a trait in the Maori character, the strong disinclination to work if they can get food, fresh air, and sunshine without it, and the rents they get by selling rights and privileges, &c., to the whites are spent in drinking bouts, spirits, as with other savage races, being their delight. Time has not improved them, as the writer recollects them some eight and twenty years ago in hundreds loitering about the streets of Auckland—men and women with pipes in their mouths, or squatted down at the wharf-side, watching with listless apathy the whites toiling at the cranes unloading ships that lay alongside, and the dusky natives would seem to betray no sign of interest in what was going on around till one of their own war canoes passed up the bay, when they would rise up and shout.

While large timber is becoming scarcer year by year in nearer latitudes, it is a pity that some stop cannot be put to the wilful waste in countries far off, but still accessible, and to which a constant stream of commerce continuously flows. The kawrie pine possesses much of the durability of the hardwood species, at the same time being easily workable. By and by this timber will come into greater use, and the regrets at the useless waste of the

fine forests that is now going on will be too late, and the great increase in the value of forest property throughout the world will awaken the colonists of these distant lands to the mistake they made in not preserving their trees from wilful destruction when they had the opportunity.

We can hardly realise trees as high as the Monument, and of equal girth, not standing singly, but in thousands, being set fire to for the purpose of clearing a roadway.—*Timber Trades Journal.*

The Longevity of Trees.—Dr. Childs, who lived in Nebraska for about thirty years, and was an observer for the Smithsonian Institution, counted rings on some soft maples eleven years two months old, and found on one side of the heart of one of them forty rings and not less than thirty-five anywhere, which were quite distinct when the wood was green; but after it had been seasoned only twenty-four rings could be distinguished. Another expert declares that all hard wood trees make many rings a year, sometimes as many as twelve; but as the last set of cells in a year's growth are very small, and the first very large, the annual growth can always be determined, except when from local causes there is in any particular year little or no cell growth. This may give a large number on one side. Upon the Pacific coast of North America trees do not reach the point where they stop growing nearly as early as those of the Atlantic coast. Two hundred years is about the greatest age attained on the eastern side of the continent by trees that retain their vigour, while five hundred years is the case of several species on the western coast; and one writer is confident that a sequoia, which was measured, was not less than 2,376 years old. At Wrangel, latitude 36° 6′, a Western hemlock, 6 feet in diameter at the stump, was 4 feet in diameter, 132 feet further up the trunk, and its rings showed 432 years. But in the old Bartram Garden, near Philadelphia, not more than 150 years old, almost all the trees are on the down grade. The *Quercus robur*, England's pride, which at home is said to live 1,000 years, has grown to full size and died in this garden, and the foreign spruces are following suit. Silver firs planted in 1800 are decaying. The great difference in the longevity of trees upon the western and eastern coasts of the continents in the Northern Hemisphere seems to be due to the warm, moist air carried by strong and permanent ocean currents from the Tropics north-easterly, in both the Pacific and Atlantic Oceans, which make the climate both moist and equable in high latitudes.—*English Mechanic.*

THE GREAT LOG RAFT.—The great log raft from Joggins, Nova Scotia, went through Hell Gate at high tide about noon on Saturday last, and passed down the East River to its destination in tow of seven tugs. The leading tug had a long length of hawser, and the others were made fast to the raft, three on each side. Little excitement was caused by its passage through the Gate, but the shores were well lined by people, all of whom seemed disappointed. From the banks the raft looked like a gigantic whale or big ship bottom upwards. There was apparently a great deal more of it below the surface than above, and from its shiplike shape and the submergence apparently of the ends, it did not look nearly as long as it was reported to be. It was really 592 feet long, 55 feet wide, and drew 23 feet of water. It was built of 24,000 logs, averaging 13 inches in diameter and 39 feet in length, and containing 5,000,000 feet of timber. The raft is cigar-shaped. The logs are bound together by wire ropes and chains. Two big tugs towed it down from the Bay of Fundy, where it has been under construction since November, when Mr. Leary's other and unfortunate venture was launched. To transport such a mass of timber by the usual method would require 45 lumber schooners and cost 30,000 dollars. The two tugs for towing it only charged 4,500 dollars. It is estimated that the owners will realise 75,000 to 100,000 dollars from their venture. The timber coasting trade is alarmed, for timber in logs can thus be shipped much cheaper in raft form than on board vessels. The Government did its utmost to impose a duty upon the raft, but did not succeed. Mr. Leary will proceed to Joggins before the autumn, where another and larger raft will be built upon the ways previously occupied by the present one.—*Timber Trades Journal.*

THE TEAK MARKET.—Messrs. Denny, Mott, and Dickson's wood market report for July 3rd states that the deliveries last month from the docks in London were 878 loads and landing 2,216 loads.

The half-year ending 30th June shows :—

Deliveries from docks in London ; 7,906 loads, as against 6,138 loads for the corresponding period last year ; landed in London 6,626 loads, as against 4,022 loads last year : present stocks in London 9,500 loads, as against 12,581 loads last year. The above increase of about 29 per cent. on the six month's consumption of last year and 25 per cent. decrease in the landed stocks is distinctly encouraging.

Some large orders are in hand, and this fact, combined with exceptionally important ship-building requirements—both actual and prospective—should give great strength to the market, notwithstanding that last month's important landings have again swelled the stock on hand to the above ample proportions. The continued scarcity of supplies of European quality trees from the forests, and also the large requirements of Burma itself, for barracks, &c., continue to keep prices at the shipping ports at a higher level than that of prices here, and should serve to check importation and keep supplies moderate, if holders on this side refrain from taking undue advantage of the situation by forcing up prices to a level which would check consumption and serve to cause the repetition of the old evil of indiscriminate shipments, with the inevitable result of a demoralised market.

A very satisfactory feature of the half-year has been the steady moderation and mutual consideration shown by all largely interested in this important wood, and this is not the least of the factors which have tended to restore the market to its present satisfactory condition.—*Timber Trades Journal.*

MANUAL OF INDIAN SYLVICULTURE.

I HAVE received numerous enquiries regarding the date when my Manual of Indian Sylviculture is likely to issue from the Press. As an answer to these enquiries, I would ask you kindly to state that the book will be ready for sale early next month, and will be procurable from the Librarian, Forest School, at Rs. 10 per copy.

DEHRA DUN,
18*th November*, 1888.

E. E. FERNANDEZ.